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OPERATIONAL FORECASTS OF TROPICAL CYCLONE FORMATION IN THE WESTERN NORTH PACIFIC IN 1991

By C D Hall

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Central Forecasting Division
Meteorological Office
London Road
Bracknell, Berkshire,
RG12 2SZ

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INTRODUCTION

Forecasts of the tracks of tropical cyclones have been verified for several operational global models and considerable skill has been demonstrated (eg Kitade, 1989). In the case of the UK operational global model (Hall, 1987) skill relative to climatology or persistence is greatest at the longer forecast ranges (T+48 to T+120). For some of the systems verified no circulation at the surface could be identified in the initial analysis; indeed the analysis time was in some instances several days prior to the first report of the tropical disturbance from which the tropical cyclone developed. The skill of the UK operational global model in predicting the formation of tropical cyclones has been investigated and results are presented here. The western North Pacific has been selected as the verification area because some of the largest systems develop in this basin and most are well resolved by the grid of the current model (0.8 degrees latitude by 1.25 degrees longitude). This model with 20 levels has only recently been introduced (June 1991) and replaced the 15-level version operational up to that time. The verification presented here only relates to the new model.

VERIFICATION METHOD

Objective measures of the skill of tropical cyclone formation are not easy to devise. Forecasts of the track may be verified by the position error at the verifying time; however, no such obvious measure exists for forecasts of formation. Errors may be made not only in the position, but also in the intensity and the time at which the deepening occurs. A simple-minded approach has been taken here to provide an objective definition of formation, both for the system in the real atmosphere and for its representation in the model forecast. Following the commonly-used criterion (eg Zehr, 1989) a tropical cyclone is defined to have formed when the system which was a tropical disturbance first becomes a tropical depression. This stage is marked by the formation of a rotational circulation with maximum sustained winds less than 33 knots. The forecast bulletins received at Bracknell in real time from JTWC Guam have been used to fix this event. For the model's representation of the tropical cyclone, formation has been related to the depth of the low in the mean sea-level pressure field. Where the model forecasts the creation of a distinct low centre, having pressure at least 6 mb lower than the monthly average value at that location, the event of formation is defined to have occurred. The 6 mb limit was selected by trial as the value most suitable for forecasting purposes; a value any lower producing an excessive number of false alarms, and a higher limit leading to the failure to forecast many actual cases of the event. There are

tropical cyclones for which the best representation on the model's rather coarse grid is only a shallow low; in such cases a forecast on the grid may be perfect yet fail to forecast formation according to the criteria set here. It may be more suitable to relate formation to some value of the low-level vorticity, but this has not been explored.

FORECASTS OF TROPICAL CYCLONE FORMATION IN 1991

Figure 1 displays forecasts of tropical cyclone formation together with the observed tropical cyclones in the western North Pacific in the period July to December 1991. The coordinates of the figure are time and longitude; time runs down each of the three columns and longitude east runs along the x-axis. The latitude of a tropical cyclone has been ignored. The normal westward movement of a system appears as a track on this diagram running from top right to bottom left. Where eastward movement occurs, say after recurvature, the orientation of the track appears reversed. All reported tropical cyclones have been plotted on this diagram as solid lines joining either a small dot (maximum winds less than 50 knots), a large closed circle (maximum winds at least 50 knots but less than 65 knots), or an open circle (system of typhoon strength). Model forecasts of tropical cyclone formation (defined as above) are plotted as numbers representing the forecast day on which the event occurred; for example a 4 means that there was a system more than 6 mb lower than average in the 4-day forecast which did not meet the criterion for formation in any of the earlier forecasts. The forecast of formation is plotted at the verification time expressed to the nearest day (only forecasts valid at 00UTC have been verified). A perfect set of forecasts would therefore be displayed by the numbers 1,2,3,4 and 5 at the top right hand end of the line depicting the tropical cyclone track through time and longitude. Errors in position east-west will appear as a displacement left or right, and errors in timing will appear as a displacement up or down. The 6 mb limit used in the definition of formation is rather arbitrary. Very successful forecasts which accurately represent the phase and speed of the disturbance from which the tropical cyclone develops (perhaps an easterly wave), may deepen the system at the wrong time. In such cases the forecasts events of formation (the numbers 1 to 5 in Figure 1) are spread diagonally along the axis of the time-longitude track of the system.

The dashed lines in Figure 1 mark out boxes around the formation stage of each of the tropical cyclones and enclose an area representing what might be considered an acceptable degree of skill for each system. Forecasts of the event of formation falling within each box have an error in longitude of less than 10 degrees and an error in time of less than 3 days. The box is tilted along the track of the system so that a forecast which has the correct phase but deepens the low too early or too late is not unduly penalised.

Only a few tropical cyclones which reach typhoon intensity do not have forecasts of formation falling within the area enclosed by the dashed line. In some cases there is a consistent set of

forecasts indicating correct formation at approximately the right time and longitude. Most of the forecasts started from an initial analysis which did not contain any circulation representing a reported tropical depression. There are instances of false alarms; notably around 140E on 31 July, around 140-160E between 23-29 September, and around 150E between 25-30 October. In the latter case a tropical depression was reported from 1 November at 135E which seemed to have the same phase and speed as the system systematically forecast to form at the earlier dates. The hit rate for all the forecasts, expressed as the percent falling within any of the boxed areas, is given below:

1-day forecasts	88%
2-day forecasts	86%
3-day forecasts	60%
4-day forecasts	48%
5-day forecasts	54%
Random at 120E	25%
Random at 140E	37%
Random at 160E	27%

Also given is the hit rate for random forecasts of formation in the period 1 July to 30 November at various longitudes. Considering the difficulty in defining the event of tropical cyclone formation, especially in the model forecasts, there is clearly a marked degree of skill in its prediction.

In order to get a clearer impression of the forecasts produced by the global model, examples for each of the systems are presented in the figures which follow. In each case the date chosen for verification (VT) is the first instance that winds in excess of 50 knots were reported at 00UTC (only forecasts from 00UTC analyses have been verified here). 6 charts are presented for each system; they are from top left to bottom right: (1) the initial analysis 5 days before VT, (2) the analysis at VT, (3) the 5-day forecast verifying at VT, (4) the 4-day forecast verifying at VT, (5) the 3-day forecast verifying at VT, and (6) the 2-day forecast verifying at VT. The reported position of the tropical cyclone is marked in the analyses by the usual symbol. In some instances a position error in the analysis of 1 or 2 degrees may be noted which reflects the limited accuracy that can be achieved by numerical data assimilation in the tropics.

ZEKE was first reported over the Philippines on 12UTC 9 July and reached 60 knots by VT=00UTC 12 July by which time it had moved east into the South China Sea. A low centre was fairly consistently forecast by the model, though in the T+120 forecast it is somewhat displaced to the east. The system subsequently reached typhoon strength before making landfall on the coast of Vietnam.

AMY was first reported on 18UTC 15 July at 134E and reached 60 knots by VT=00UTC 17 July. For this system the T+120 and T+48 forecasts both showed the formation of a good circulation with a closed 1004 mb isobar. The circulation in the T+96 and T+72 forecasts was less distinct and the 6mb limit was not met, but the position was accurately predicted. Amy subsequently reached typhoon strength and made landfall over mainland China.

BRENDAN was first reported on 00UTC 21 July just to the east of the Philippines and reached 65 knots by VT=00UTC 22 July. At this time another low centre lay at around 140E which was later to develop into CAITLIN. The formation of BRENDAN was predicted in none of the forecasts shown; in all cases the model developed CAITLIN prematurely and at the same time tracked it too far west. BRENDAN was short lived making landfall in southern China.

CAITLIN was first reported on 12UTC 23 July although it had existed as a low centre for some days before. It reached 50 knots by VT=00UTC 25 July. All forecasts showed cyclone development in the area though somewhat unusually the T+120 forecast had the best position. The typhoon subsequently recurved and hit South Korea on the 27th.

DOUG was first reported on 9 August but did not reach more than 35 knots before becoming extratropical. It marked the beginning of a very active period in the western North Pacific when 5 systems developed over 7 days.

ELLIE formed in the large complex area of low pressure which was left in the wake of DOUG. It was first reported on 18UTC 10 August at 24N 157E and by VT=00UTC 13 August it had reached 50 knots. A complex pattern was forecast by the model, but the detail of which low developed where was seldom predicted correctly. At VT all forecasts show a low some distance to the south east of the actual position of ELLIE. This may be a large position error, but it seems more likely that the model has developed the wrong system;.in fact there was a short-lived tropical depression (13W) reported at the same time and place. In the T+48 and T+72 forecasts a troughing of the isobars is shown at around 27N 150E is probably an attempt to represent ELLIE. The typhoon subsequently tracked west and dissipated after crossing Taiwan.

FRED was first reported on 12UTC 11 August just to the east of the Philippines. It moved into the South China Sea and reached 50 knots by VT=00UTC 14 August as a shallow feature in the mslp analysis. Although all forecasts show some low in the area they are really completely inaccurate. The model develops its lows over mainland China, and after deepening in the Gulf of Tongking they move steadily east. In reality FRED was a westward-moving system, a feature not even picked up in later forecasts from analyses in which the system was present. It seems likely that this system was too small for the model to resolve.

13W was a minor tropical depression first reported on 121200 August, lasting just one day.

GLADYS formed in the base of the complex area of low pressure from which DOUG, ELLIE and 13W had spawned. It was first reported at 00UTC 16 August but model forecasts had been prematurely developing a deep low in this region for several days previously, as can be seen in the forecasts for ELLIE. GLADYS slowly intensified and reached 55 knots by VT=00UTC 18 August by which time it had become a very large system. All forecasts show the development of a large low, although at T+120 it is positioned too

far east. The system reached typhoon strength and tracked slowly north west to make landfall in South Korea.

15W and HARRY were minor tropical systems which formed to the south of Japan before tracking north to become extra tropical.

IVY was first reported at 12UTC 2 September and moved slowly west at around 10N intensifying to 65 knots by VT=00UTC 5 September. Model forecasts consistently showed an intense circulation in most cases the position was too far north east. The typhoon subsequently had maximum winds of 115 knots and tracked north west before recurving just to the south of Japan.

JOEL was a tropical storm developing in the South China Sea which failed to reach the 50 knot limit set for this verification.

KINNA followed a track similar to that of IVY but displaced a bit to the west. It was first reported at 12UTC 10 September and reached 55 knots by VT=00UTC 12 September. Model forecasts consistently showed a large circulation, but after an excellent T+120 the following forecasts all had the position too far south east.

LUKE was the first of three tropical cyclones to form almost simultaneously in the western North Pacific. It was first reported on 18UTC 14 September and reached 50 knots by 00UTC 17 September. The forecasts for this tropical storm were very good except, as in other cases, the model deepened the system prematurely. The forecast position at T+120 lay too far east but at all other lead times the error was small. The system recurved over Japan two days later.

MIREILLE was long lived and very intense but for much of its early life the circulation was small scale. It was first reported on 00UTC 16 September with intensity 50 knots which quickly increased to typhoon strength. The forecasts for this time all show a low at its early stages of development not yet meeting the 6mb limit. The position at T+120 lies a little too far east. The typhoon moved steadily north east intensifying to 130 knots and recurving to pass just to the north of Japan.

NAT was the final tropical cyclone of the triumvirate forming just to the north of the Philippines also on 00UTC 16 September. Its track and intensity were greatly influenced by the other two and it did not reach 50 knots until VT=00UTC 21 September when LUKE had disappeared from the scene. At this time the track was at its easternmost point, as the cyclone then retreated back into the South China Sea to let MIREILLE pass. All forecasts at VT show some representation of NAT at around 20N in spite of losing the system between 17-19 September while LUKE dominated the pattern. It lies too far east at around 130-135E. The second centres at 145W are forecasts of MIREILLE.

ORCHID was first reported on 00UTC 4 October, but there had been an identifiable low in the analysed mslp field associated with this system for the previous two days. It reached 50 knots on VT=00UTC 5 October by which time it had acquired a large

circulation. All forecasts verifying this time are very accurate, though as has been noted before the predicted deepening occurred several days prematurely. The typhoon eventually recurved south of Japan.

PAT developed 20 degrees to the east of ORCHID, followed it west, then became caught up in its circulation and dumb-belled north to win the race to high latitudes. It was first reported on 12UTC 5 October and by VT=00UTC 7 October reached 60 knots. The system is well forecast at all forecast periods, the only errors being slightly excessive depth and displacement east.

RUTH was first reported on 18UTC 20 October at 145E and reached 55 knots by 00UTC 22 October. T+96, T+72 and T+48 forecasts verifying this time were very good for both depth and position, however, the T+120 forecast had no closed 1004mb isobar but had a trough of about the right phase. By this date the subtropical high had built and the typhoon tracked east becoming one of the most intense of the season with maximum winds of 140 knots.

SETH was the first of another cyclone triumvirate. Reported on 00UTC 1 November it reached 75 knots by VT=00UTC 3 November while at the same time THELMA had formed 20 degrees to the west. The verifying forecasts all show a pair of lows in very nearly the correct positions; the one for THELMA being slightly too intense, and the one for SETH too weak. The model had in fact been forecasting genesis associated with THELMA from each run of the previous week. Although these proved to be false alarms their phase exactly matched that of the real cyclone which developed but never achieved winds of more than 45 knots.

VERNE was the third cyclone of the sequence. It was first reported on 18UTC 5 November and quietly followed some 15-20 degrees behind SETH before winds reached 55 knots on VT=00UTC 9 November. Again the model correctly forecasts a cyclone pair except at T+120 where the two lows are very shallow and fail to have a closed isobar. The tracks of the two lows were quite different; SETH continued west into the South China Sea, while VERNE headed due north.

WILDA developed just to the east of the Philippines on 18UTC 14 November and tracked slowly west with winds reaching 50 knots by VT=00UTC 17 November. The low in the analysis was at all times quite shallow, and the verifying forecasts have a weak low a little to the east of the actual centre. This is a case where the forecasts are not badly in error, and the 6mb criteria for formation does not work well. WILDA continued west and dissipated before reaching the coast of Vietnam.

YURI was first reported on 06UTC 23 November and winds reached 70 knots by VT=00UTC 25 November. All verifying forecasts have a good representation of the low centre but the T+120 and T+96 forecasts have it positioned too far west. The cyclone became the most intense of the season at 145 knots at recurved out of harms way in the central Pacific.

ZELDA formed at 174E on 18UTC 27 November and followed some way

behind YURI with winds reaching 70 knots on VT=00UTC 30 November. It always remained a small-scale system which is probably the reason why the model failed to resolve it on most occasions. The T+120 forecast at the verification time has a weak low centre in approximately the right place, as indeed had earlier forecasts, but after this time the model seemed to loose interest as it concentrated on developing the intense YURI. ZELDA eventually finished up following the larger typhoon north.

All the above cases verify forecasts of tropical cyclones that developed; it was noted in Figure 1 that there were a number of false alarms and the final Figure gives an example. Genesis was forecast fairly consistently at around 140E from several runs at the end of July. For VT=00UTC 2 August the T+120 forecast shows a massive circulation where in reality there was none. In subsequent forecasts the low was less deep at this time, but it was not until 31 July, 6 days after the first false alarm for this system, that the model predicted no development in the area. The model characteristically shows great consistency from forecast run to forecast run, because its data assimilation system is able to carry forward information contained in data at earlier times. This usually has great advantages in the data-sparse tropics. However, on occasions errors are also carried forward from one run to the next leading to a set of quite consistent, but totally erroneous forecasts as was the case here.

DISCUSSION AND CONCLUSIONS

The formation of a tropical cyclone is a relatively rare event and over the globe there are about 80 each year which reach an intensity of 50 knots or more. They are found in all tropical ocean basins except the South Atlantic and eastern South Pacific and their development seems clearly related to the sea-surface temperature; a value of 26.5C is commonly taken as the lower limit below which tropical cyclone formation will not occur. The mechanisms of genesis are not well understood. Certain necessary conditions have been identified (Frank, 1987; based on Gray, 1975):

1. Warm SST coupled with a relatively deep mixed layer in the ocean;
2. larger than normal values of absolute vorticity in the lower troposphere;
3. weak vertical wind shear allowing vertical coupling within the pre-storm disturbance; and
4. mean upward motion and high mid-level humidities.

These conditions are met over large areas of the tropical oceans and are not alone sufficient to predict which cloud clusters will develop into tropical cyclones and which will not. The majority of systems develop in the shear line of the monsoon trough where the equatorial surface westerly flow meets the easterly trades. A smaller number form from easterly waves which may have their origins a very large distance from the point of genesis. Easterly waves are a common means of tropical cyclone genesis in the North Atlantic and derive over the highland regions of the sub-Sahara. A third and less-common method of genesis occurs in baroclinic regions associated with mid-latitude systems.

Several synoptic-scale features or developments have been identified which may lead to tropical cyclone genesis. Riehl (1954) noted that tropical cyclones often develop out of a pre-existing circulation. This provides the large-scale upward motion and moisture transport which has already been noted as a precondition for genesis. Surges in the low-level flow have also been identified as an important trigger mechanism. Cold surges in the winter hemisphere can induce an intensification of the westerly flow into the monsoon trough in the other hemisphere (Love, 1985a,b). Similarly an intensification of the sub-tropical high can lead to a surge in the easterly trades which in turn induces tropical cyclone genesis. In a study of FGGE analyses in the western North Pacific, Lee (1986) identified surges in the southwesterly monsoon flow in late summer as another mechanism for genesis. The role of low-level wind surges observed by aircraft flights within the circulation of incipient tropical cyclones has been reported by Gray (1989), based on Middlebrooke (1988). The wind structure of those disturbances which subsequently developed was shown to be anomalous in the radial component but not in the tangential component. The systems which had a strong asymmetry in the flow towards the centre were most likely to develop.

Another important factor for the deepening phase, and possibly also tropical cyclone genesis, is the existence of outflow jets at 200 mb or thereabouts (Sadler,1978). These connect the upper anticyclone over the incipient tropical cyclone with the tropical upper-tropospheric trough (TUTT) or, for example, a cold low originating from middle latitudes. It is often the case that tropical cyclones develop sequentially with one following closely behind the other, as indeed can be noticed in the cases presented here. Using composite analyses, Frank(1982) demonstrated how a tropical cyclone modifies the large-scale vertical-velocity field in such a way as to favour genesis in its wake. On the longer time scale there is evidence of a clustering of events of tropical cyclone genesis with a 4-6 week period (Gray,1985) with a possible connection with the 40-50 day tropical oscillation.

Many of the above factors relate to features of the large-scale tropical flow which fall within the range of systems resolved by current operational data assimilation schemes given their resolution and the availability of observations in real-time. For this reason it is not surprising that some skill can be shown by numerical models in the forecasting of of tropical cyclone genesis. Studies with global models have often been restricted to individual cases: Krishnamurti et al (1989) with FGGE data and Reed et al (1986) with easterly waves. The cases presented here for the western North Pacific relate to operational forecasts of all tropical cyclones that developed between July and November 1991. Some characteristics of the forecasts from the UK model may be noted:

1. Many of the successful forecasts started from initial analyses having no circulation for the system which was to develop. Indeed the forecast of tropical cyclone genesis might be made several days prior to the first reports of the presence of a tropical disturbance.

2. Skill does not fall off rapidly with lead time; 5-day forecasts of genesis are significantly better than random forecasts of the event.

3. Complex patterns having two or more systems close together are not well handled. The model may well develop the wrong one. Large systems are forecast better than small systems. Put another way: simple large systems are forecast best.

4. Late season cyclones were well forecast. All developed at low latitudes in the monsoon trough.

5. On occasions when tropical cyclones develop there is a tendency for the forecast pressure to be too low and individual cyclones are forecast to deepen prematurely.

Models are only able to perform as well as the available data allows. In the tropics cloud-motion winds and surface reports are the most plentiful source of data, while radiosondes and aircraft reports are sparsely distributed. A dense cover of satellite temperature soundings is also available, but their value is limited because of the weak coupling of the mass and wind fields at these latitudes. An important aspect of data assimilation is its ability to spread information from middle latitudes where the data cover is good, and this is a major contribution to the accuracy of analyses in those parts of the tropics where virtually no observations are available. In general, numerical analyses in the tropics are not as good as in middle latitudes, especially in the representation of small-scale features. However, the large-scale flow, including the main convergence zones and areas of large-scale ascent, are usually all present in the initial conditions from which these forecasts have been made.

The UK operational model with a horizontal resolution of about 100km shows considerable accuracy in the forecasts of genesis even at T+120. The information has been extracted from analyses with accuracy restricted principally to the large scale for the reasons outlined above. This implies that the ultimate mechanism for the formation of these cyclones must also lie in the large-scale flow. Further studies of the cases is required to identify what synoptic features analysed by the model are critical for the process of genesis.

REFERENCES

Frank,W.M.,1982: Large-scale characteristics of tropical cyclones. Mon.Wea.Rev., 110, 572-586.

Frank,W.M.,1987: Tropical cyclone formation. A global view of tropical cyclones. Edited by R.L.Elsberry, Chapter 3, 53-90.

Gray,W.M.,1975: Tropical cyclone genesis. Dept.Atmos.Sci. Paper No. 232, Colorado State University, 121pp.

Gray,W.M.,1985: Tropical cyclone global climatology. WMO/TD No.72, Vol I, 3-19.

Gray,W.M.,1989: Tropical cyclone formation. Topic chairman and rapporteur reports of the second WMO International Workshop on Tropical Cyclones, WMO/TD No.319, 3.0.1-3.0.27.

Hall,C.D.,1987: Verification of global model forecasts of tropical cyclones during 1986. Meteorolog.Mag., 116, 216-220.

Kitade,T.,1989: Global model forecasts of tropical cyclones. Topic chairman and rapporteur reports of the second WMO International Workshop on Tropical Cyclones, WMO/TD No.319, 1.2.1-1.2.9.

Krishnamurti,T.N., D.Oosterhof, and N.Dignon,1989: Hurricane prediction with a high-resolution global model. Mon.Wea.Rev., 117, 631-669.

Lee,C-S.,1986: An observational study of tropical cloud cluster evolution and cyclogenesis in the western North Pacific. Dept. Atmos. Sci. Paper No. 403, Colorado State University, 250pp.

Love,G.,1985a: Cross-equatorial influence of winter hemisphere subtropical cold surges. Mon.Wea.Rev., 113, 1487-1498.

Love,G.,1985b: Cross-equatorial interactions during tropical cyclogenesis. Mon.Wea.Rev., 113, 1499-1509.

Middlebrooke,M.G.,1988: Investigation of tropical cyclone genesis and development using low-level aircraft flight data. Dept. Atmos. Sci. Paper No. 429, Colorado State University.

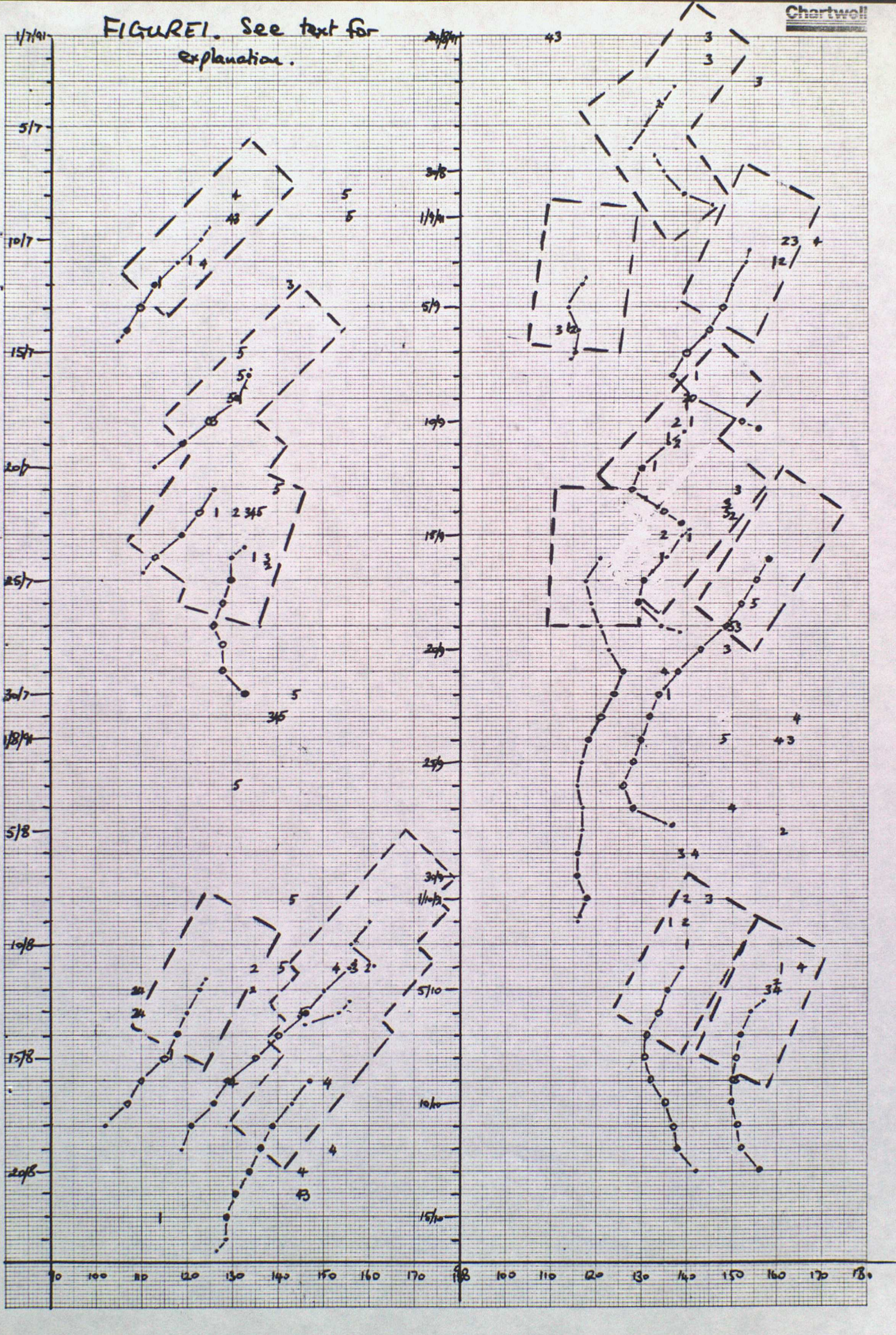
Reed,R.J., A.Hollingsworth, W.A.Heckley, and F.Desol,1986: An evaluation of the performance of the ECMWF operational forecasting system in analysing and forecasting tropical easterly wave disturbances. Part 1: Synoptic investigation. ECMWF Tech. Rep. No. 58, 75pp.

Riehl,H.,1954: Tropical Meteorology. McGraw-Hill,392pp.

Sadler,J.C.,1978: Mid-season typhoon development and intensity changes and the tropical upper tropospheric trough. Mon.Wea.Rev., 106, 1137-1152.

Zehr,R.,1989: Advances with forecasting techniques. Topic chairman and rapporteur reports of the second WMO International Workshop on Tropical Cyclones, WMO/TD No.319, 3.3.1-3.3.15.

FIGURE 1. See text for explanation.



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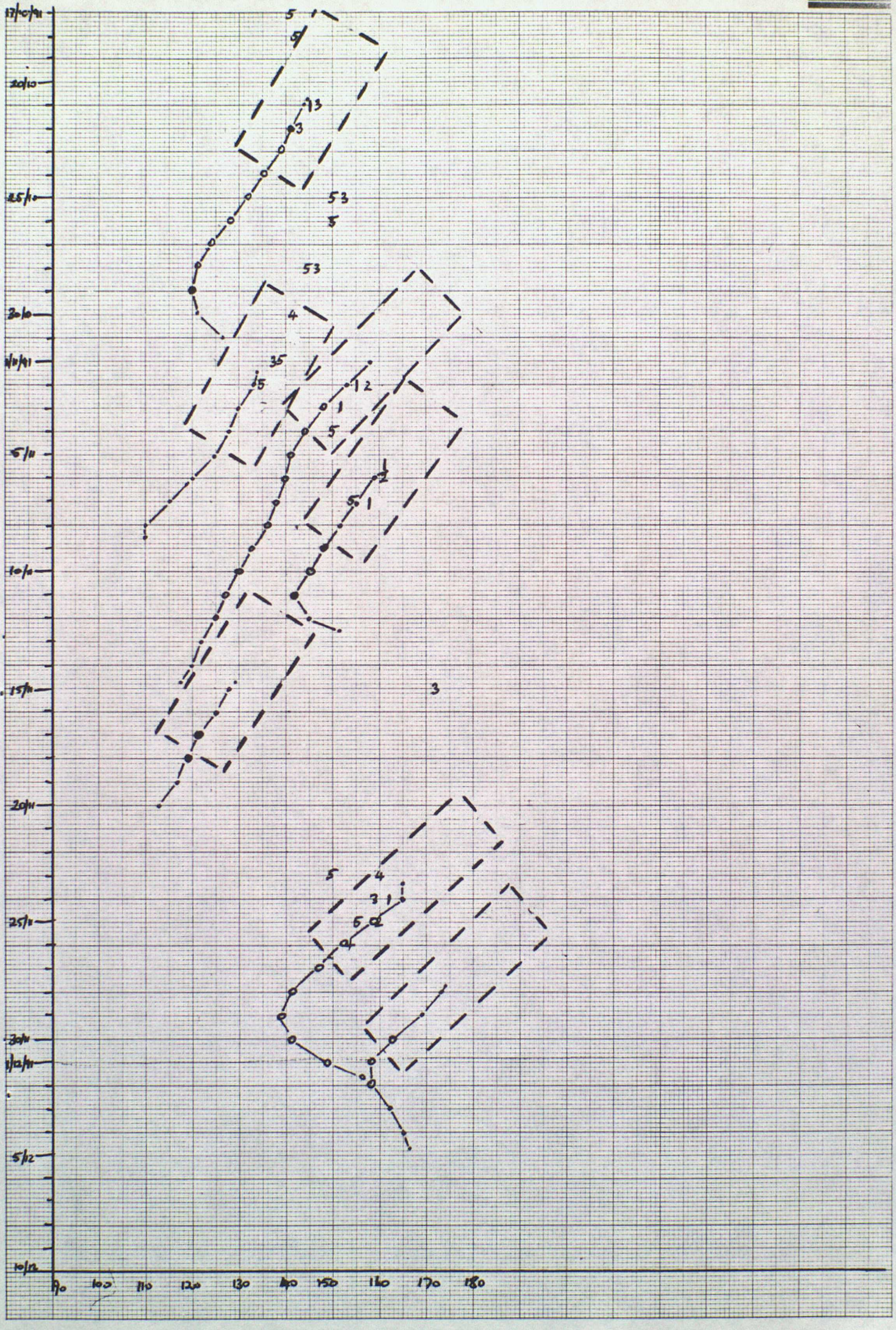
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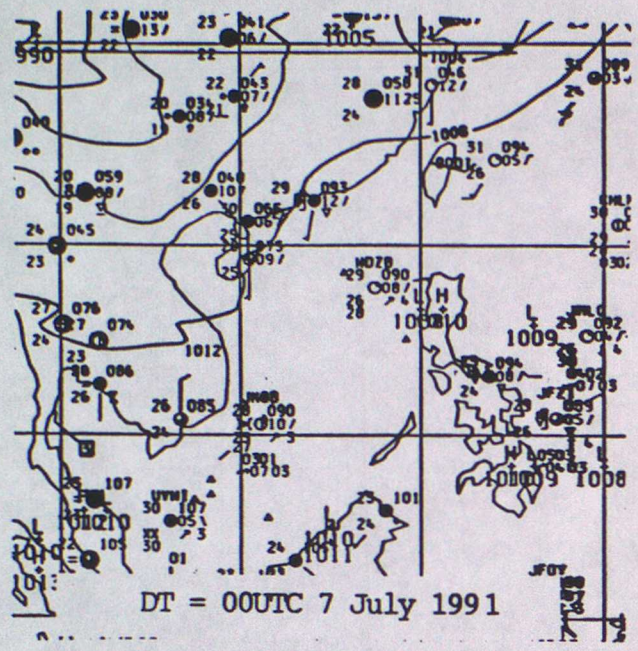

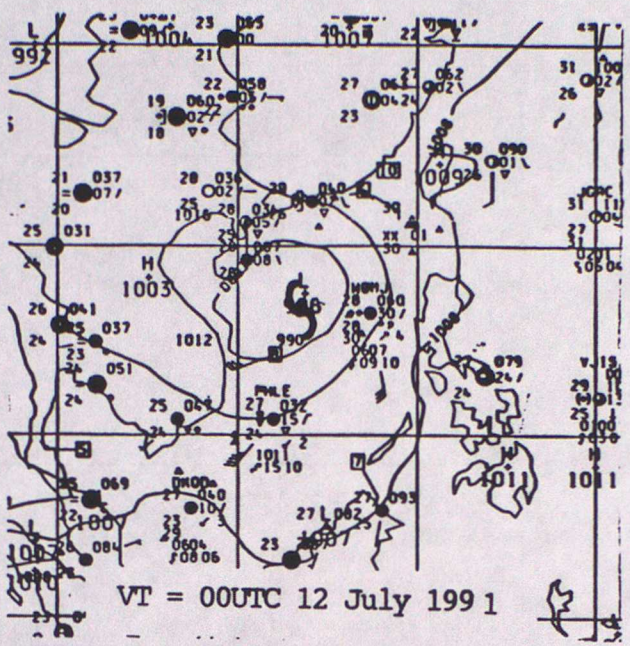

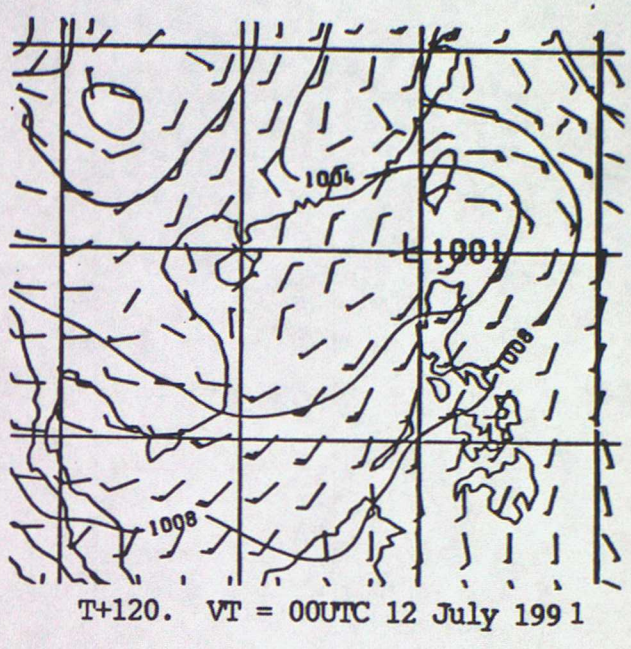

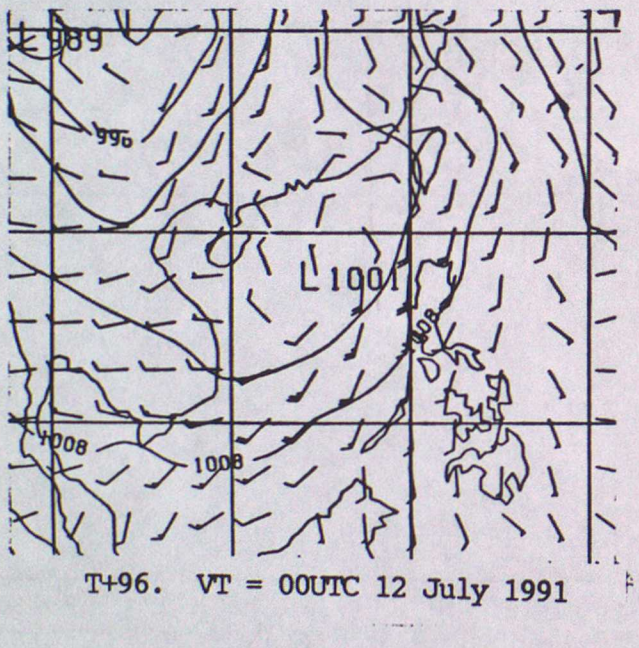

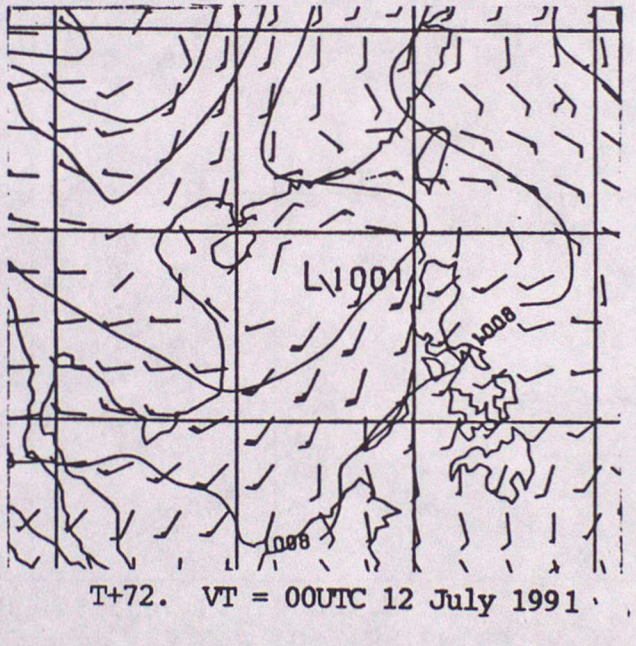

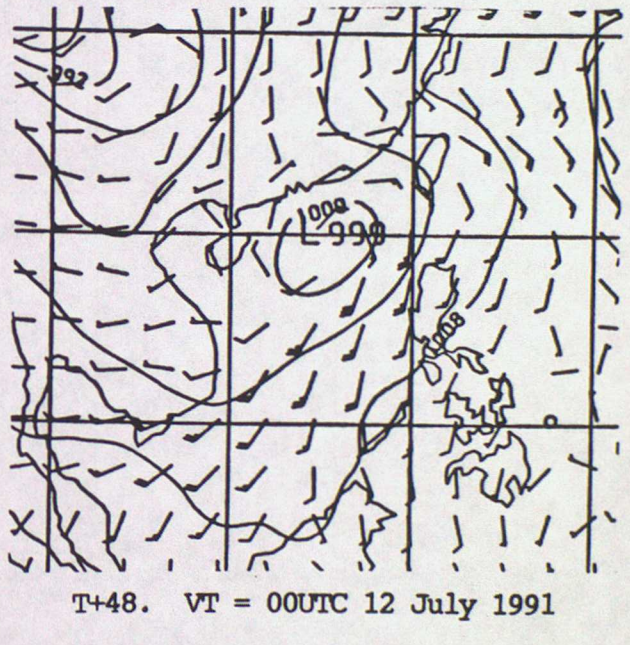

Figure 2. ZEKE. Verification time VT = 00UTC 12 July 1991

First reported 12UTC 9 July 1991 (VT-60).

UAMS

DATA DERIVED FROM CM OPD 1 MAY 1990- 31 JUN 1990 & PLOTTED BY BAND(SIGMA DTA)
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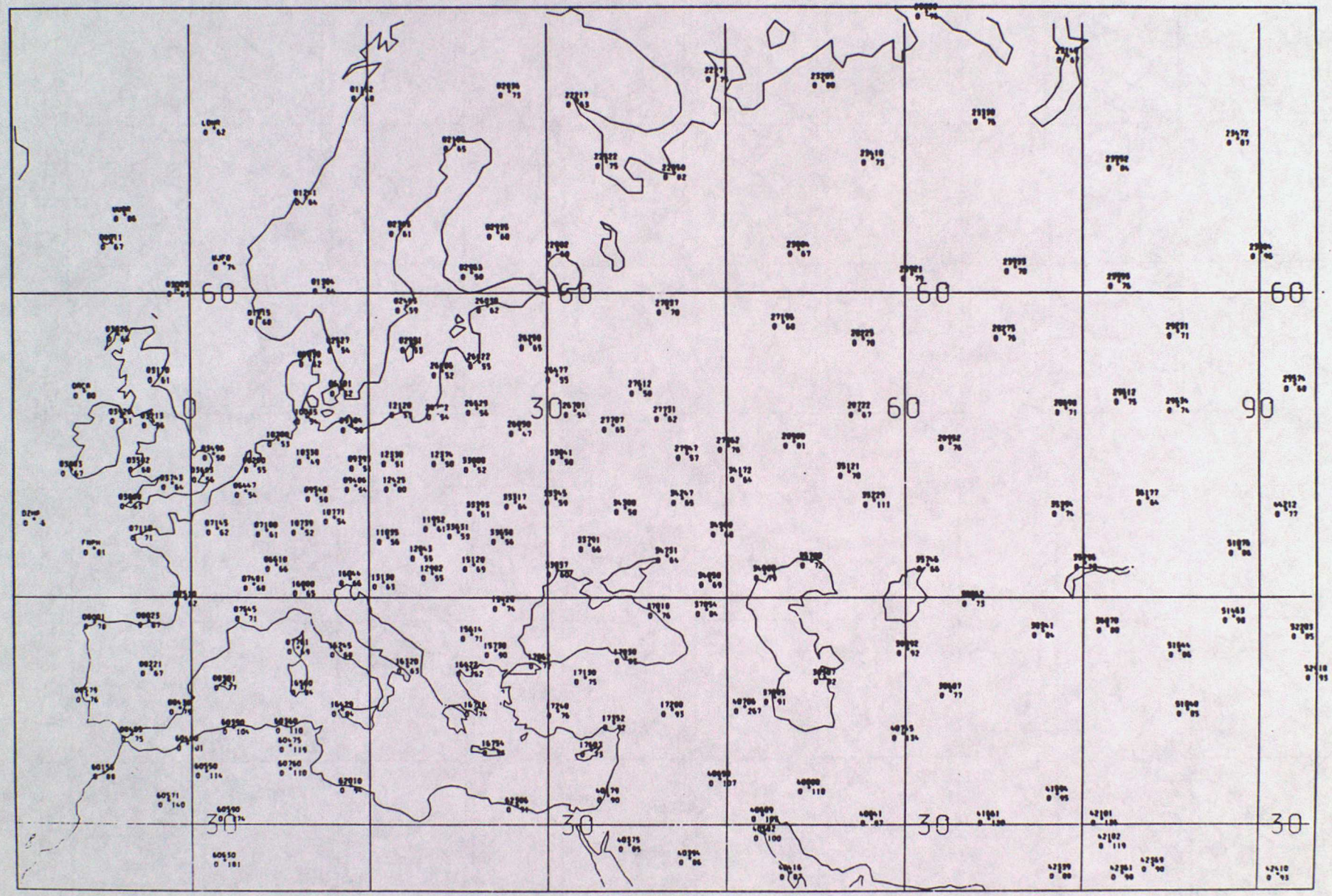
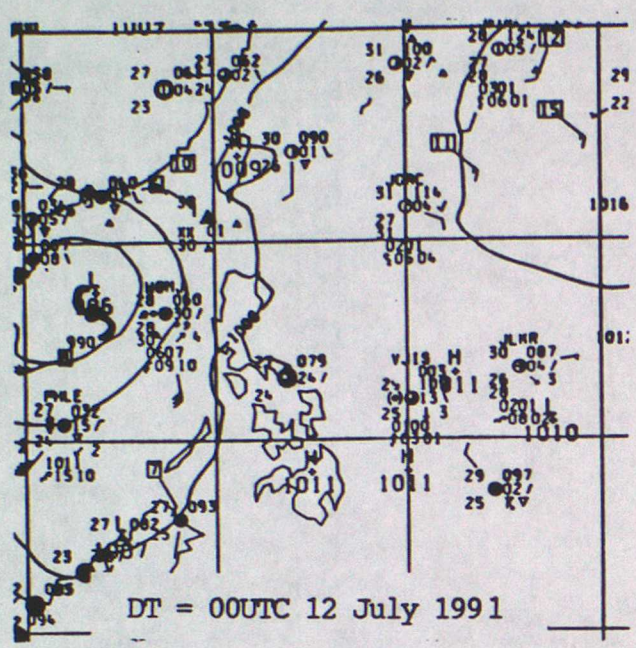
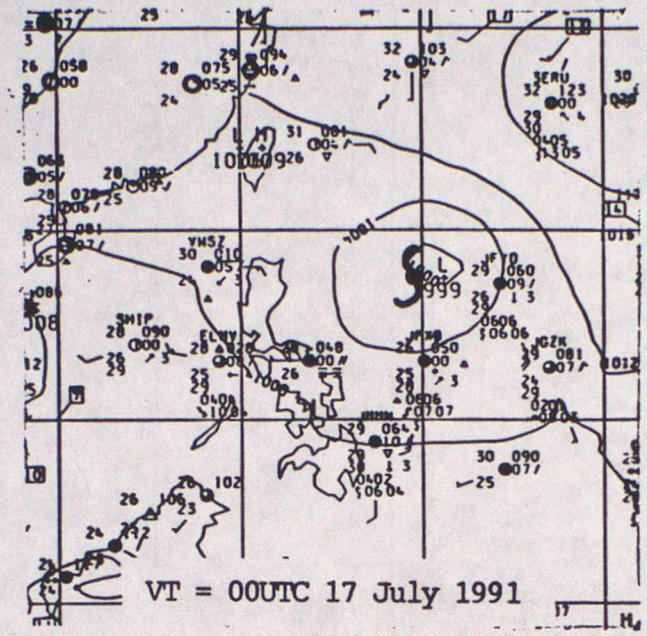
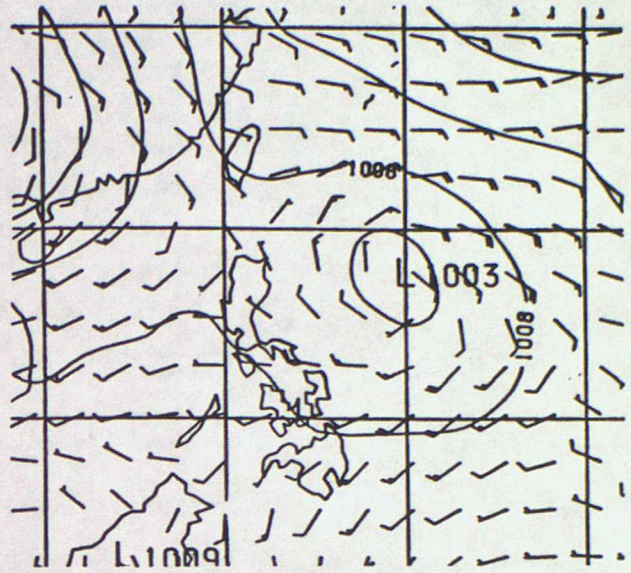




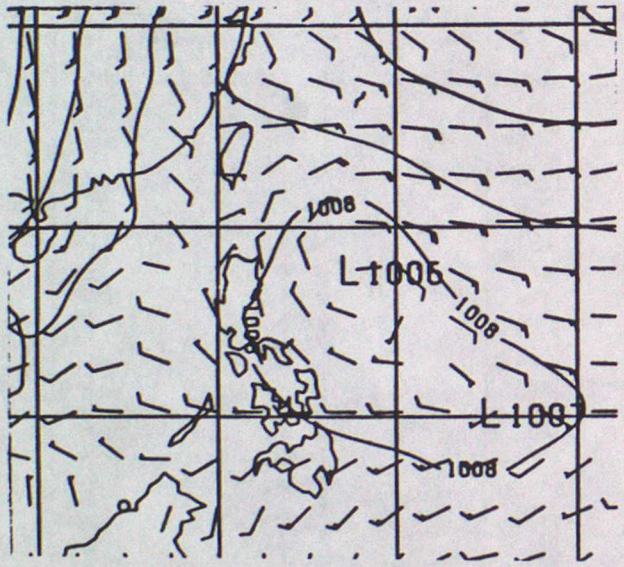
DT = 00UTC 12 July 1991



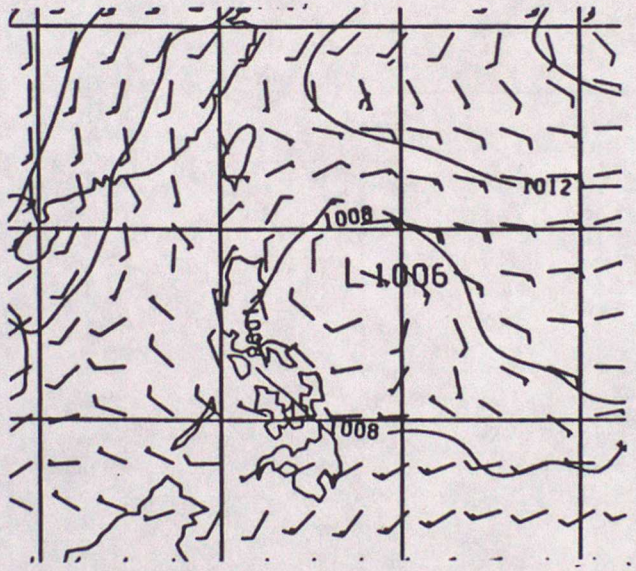
VT = 00UTC 17 July 1991



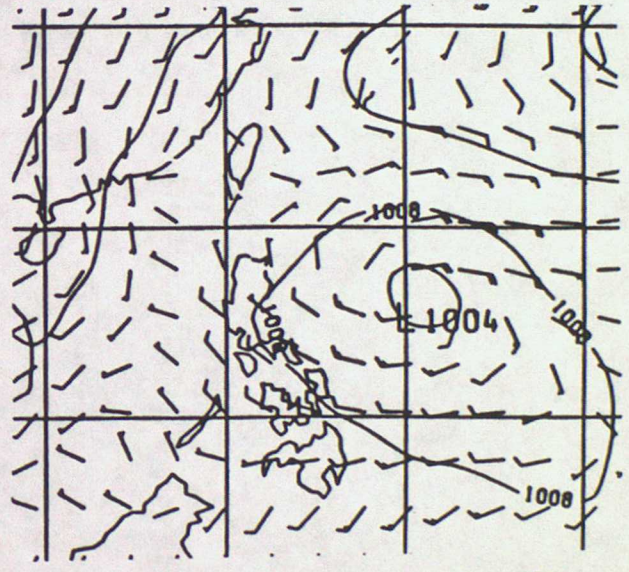
T+120. VT = 00UTC 17 July 1991



T+96. VT = 00UTC 17 July 1991



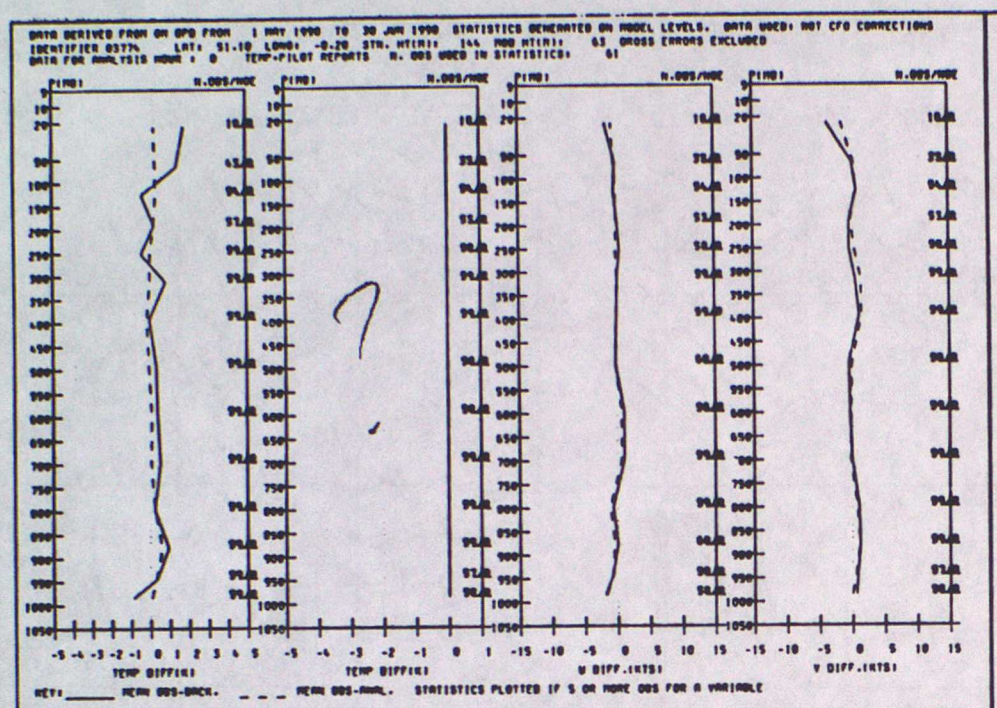
T+72. VT = 00UTC 17 July 1991

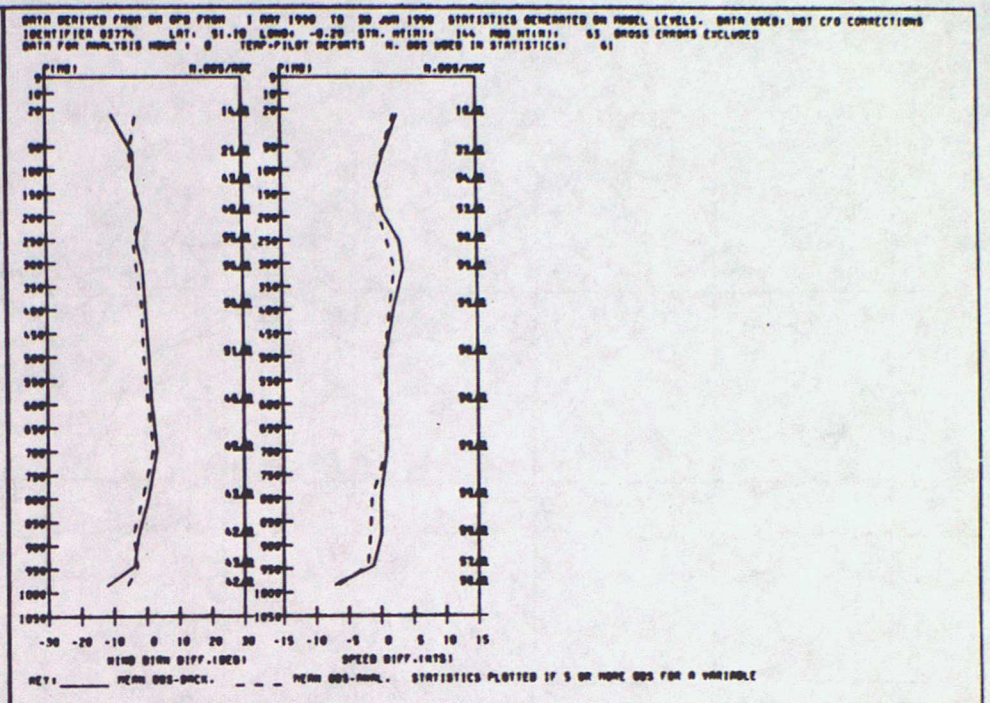


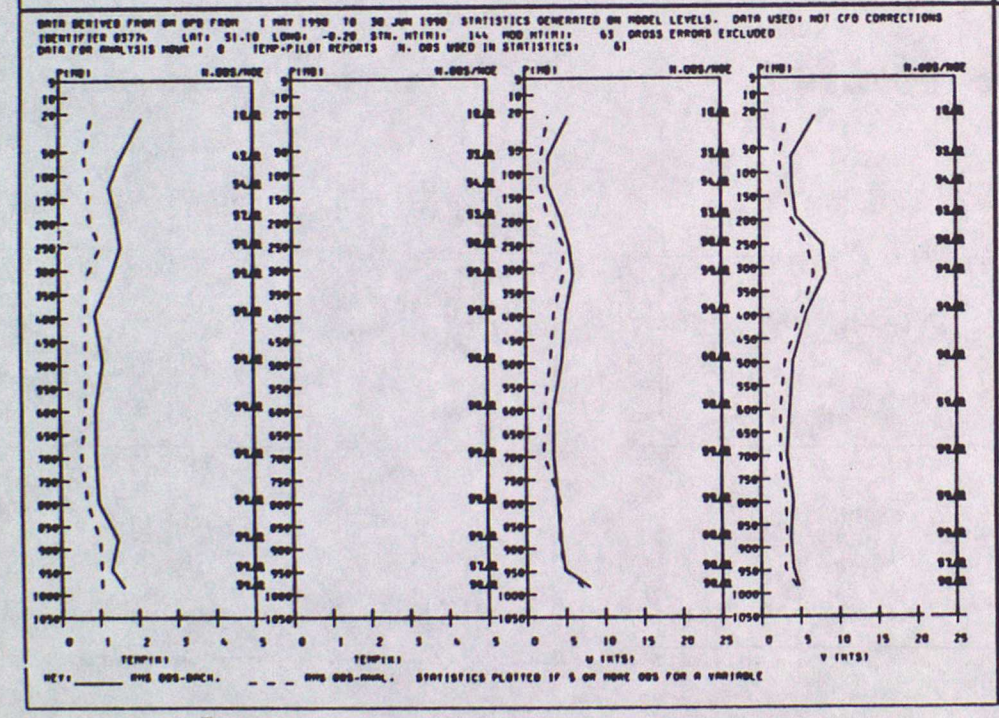
T+48. VT = 00UTC 17 July 1991

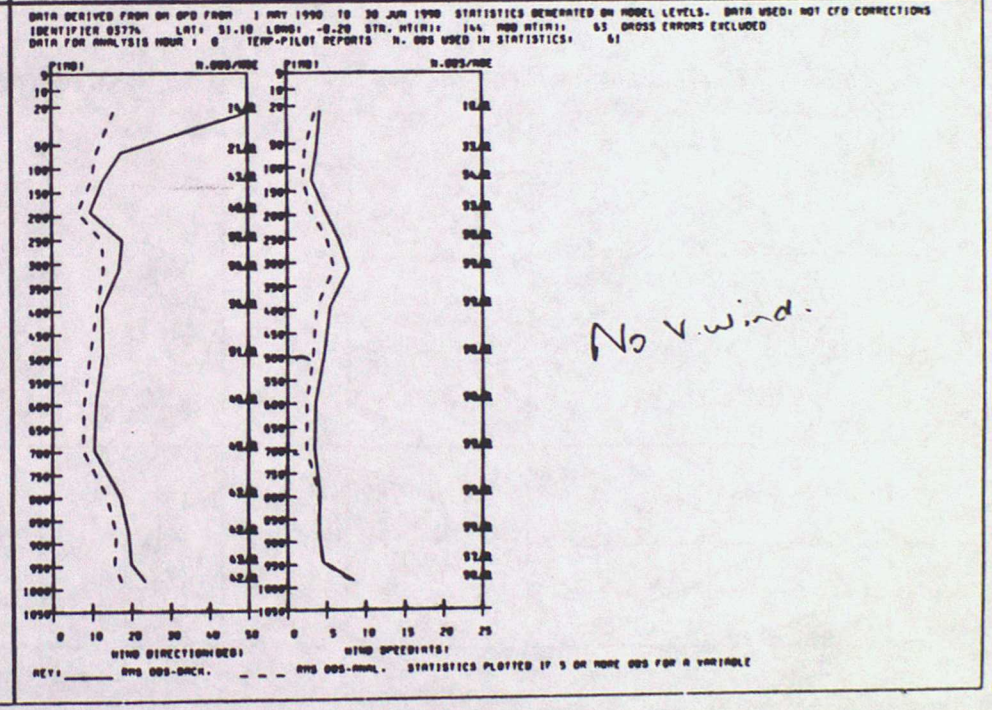
Figure 3. AMY. Verification time VT = 00UTC 17 July 1991 First reported 18UTC 15 July 1991 (VT-30).

MAC

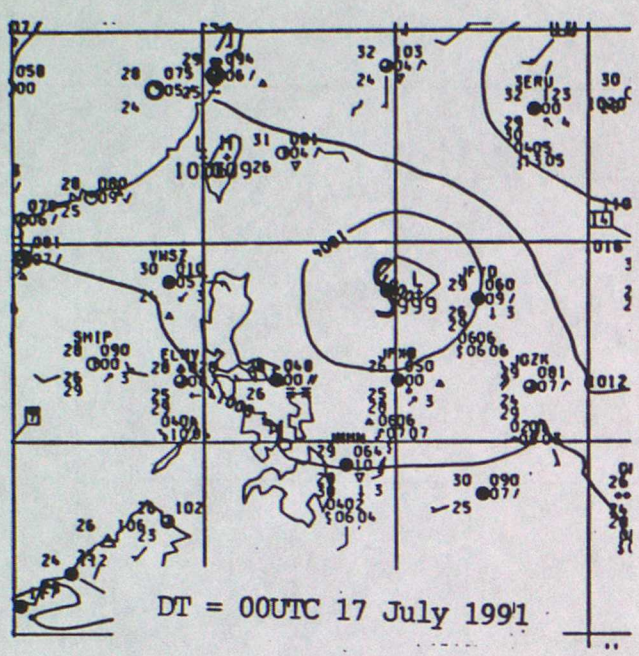

DATA DERIVED FROM OM GPD FROM 1 MAY 1990 TO 30 JUN 1990 STATISTICS GENERATED ON MODEL LEVELS. DATA USED: NOT CFD CORRECTIONS
IDENTIFIER 0377% LAT: 51.10 LONG: -0.20 STN. HT(M): 144 ANO HT(M): 65 GROSS ERRORS EXCLUDED
DATA FOR ANALYSIS HOUR : 0 TEMP+PILOT REPORTS N. OBS USED IN STATISTICS: 61
P(MB) N.OBS/MDE
TEMP DIFF(K)
TEMP DIFF(K)
U DIFF.(KTS)
V DIFF.(KTS)
KEY: MEAN OBS-BACK. MEAN OBS-ANAL. STATISTICS PLOTTED IF 5 OR MORE OBS FOR A VARIABLE

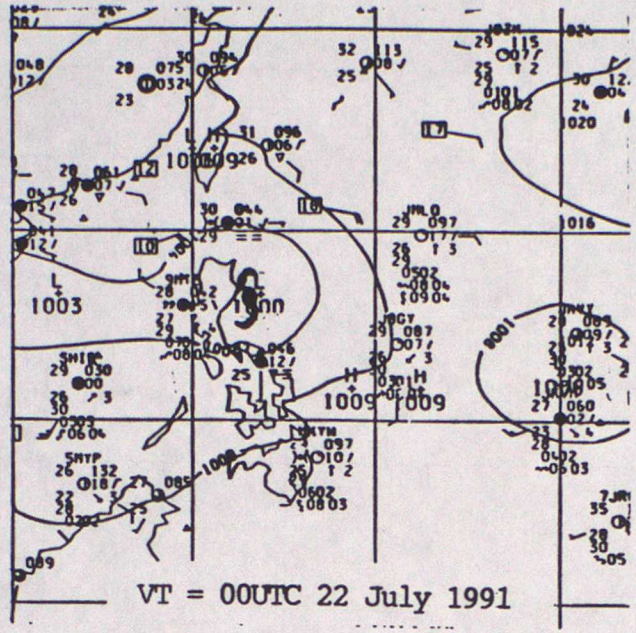

DATA DERIVED FROM OM GPD FROM 1 MAY 1990 TO 30 JUN 1990 STATISTICS GENERATED ON MODEL LEVELS. DATA USED: NOT CFD CORRECTIONS
IDENTIFIER 0377% LAT: 51.10 LONG: -0.20 STN. HT(M): 144 ANO HT(M): 65 GROSS ERRORS EXCLUDED
DATA FOR ANALYSIS HOUR : 0 TEMP+PILOT REPORTS N. OBS USED IN STATISTICS: 61
P(MB) N.OBS/MDE
WIND DIRN DIFF.(DEG)
SPEED DIFF.(KTS)
KEY: MEAN OBS-BACK. MEAN OBS-ANAL. STATISTICS PLOTTED IF 5 OR MORE OBS FOR A VARIABLE

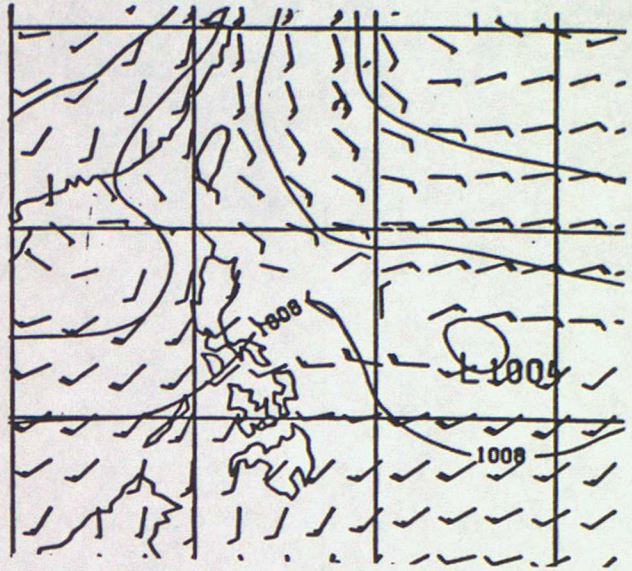

DATA DERIVED FROM OM GPD FROM 1 MAY 1990 TO 30 JUN 1990 STATISTICS GENERATED ON MODEL LEVELS. DATA USED: NOT CFD CORRECTIONS
IDENTIFIER 0377% LAT: 51.10 LONG: -0.20 STN. HT(M): 144 ANO HT(M): 65 GROSS ERRORS EXCLUDED
DATA FOR ANALYSIS HOUR : 0 TEMP+PILOT REPORTS N. OBS USED IN STATISTICS: 61
P(MB) N.OBS/MDE
TEMP(K)
TEMP(K)
U (KTS)
V (KTS)
KEY: ANO OBS-BACK. ANO OBS-ANAL. STATISTICS PLOTTED IF 5 OR MORE OBS FOR A VARIABLE

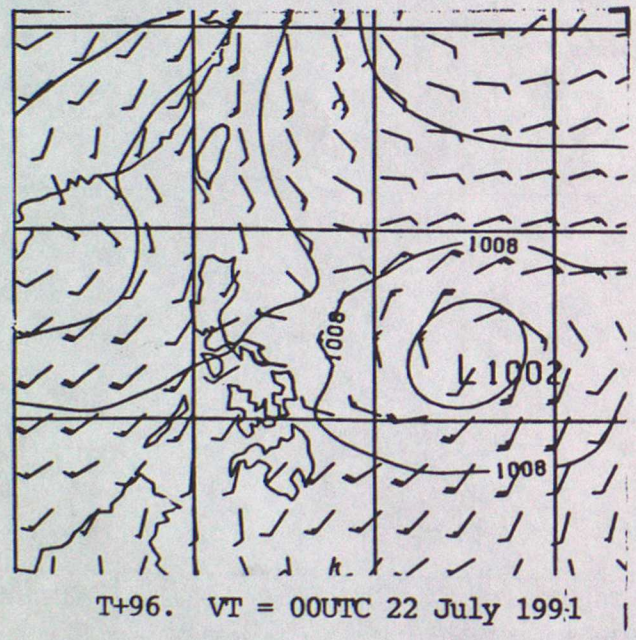

DATA DERIVED FROM OM GPD FROM 1 MAY 1990 TO 30 JUN 1990 STATISTICS GENERATED ON MODEL LEVELS. DATA USED: NOT CFD CORRECTIONS
IDENTIFIER 0377% LAT: 51.10 LONG: -0.20 STN. HT(M): 144 ANO HT(M): 65 GROSS ERRORS EXCLUDED
DATA FOR ANALYSIS HOUR : 0 TEMP+PILOT REPORTS N. OBS USED IN STATISTICS: 61
P(MB) N.OBS/MDE
WIND DIRECTION(DEG)
WIND SPEED(KTS)
KEY: ANO OBS-BACK. ANO OBS-ANAL. STATISTICS PLOTTED IF 5 OR MORE OBS FOR A VARIABLE

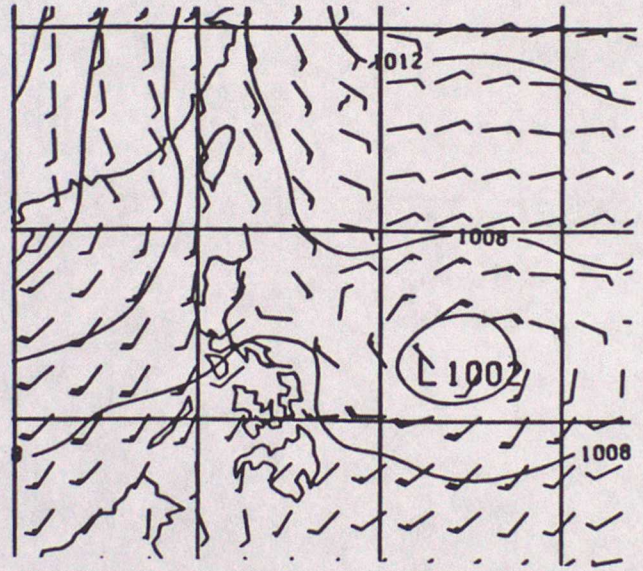
No V. wind.











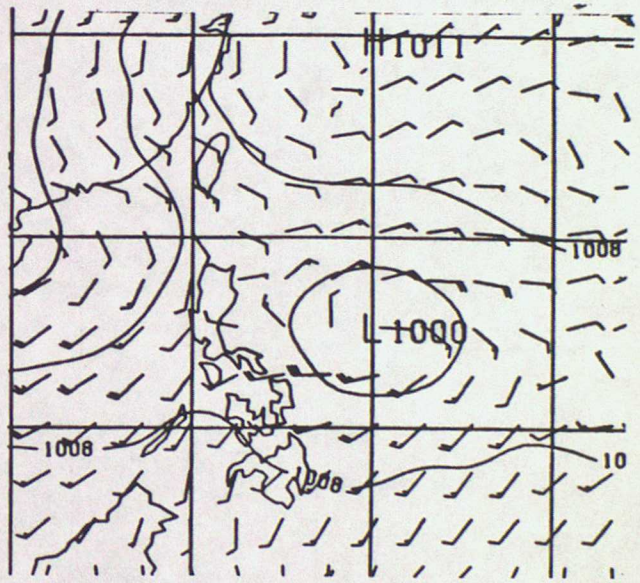
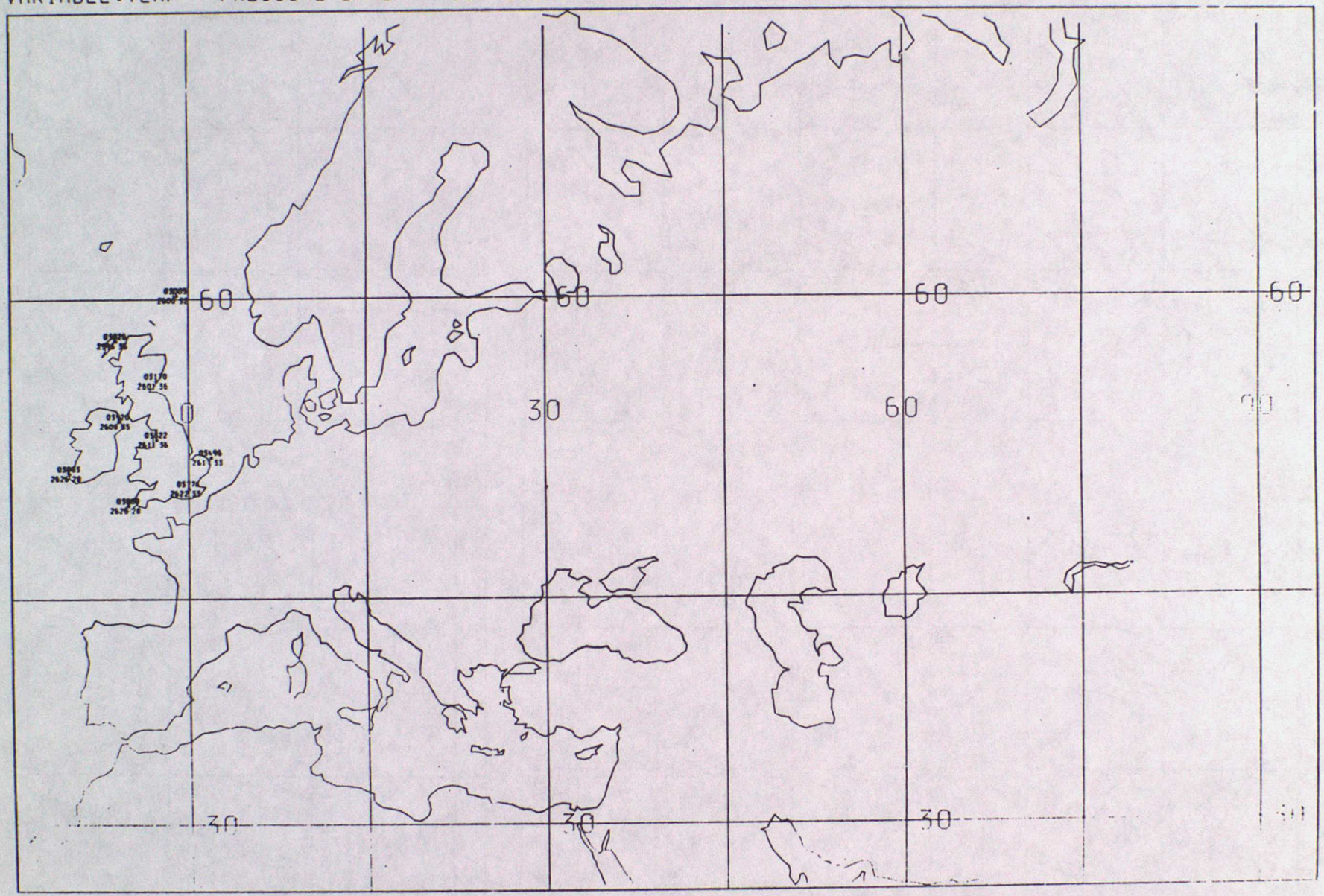
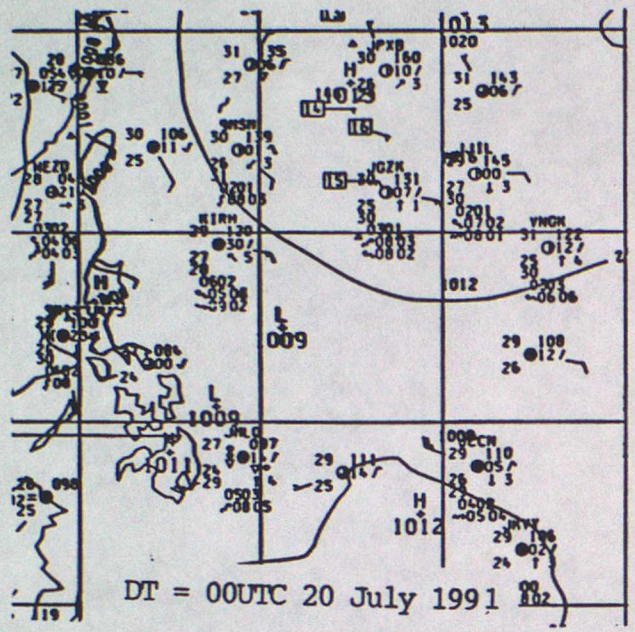
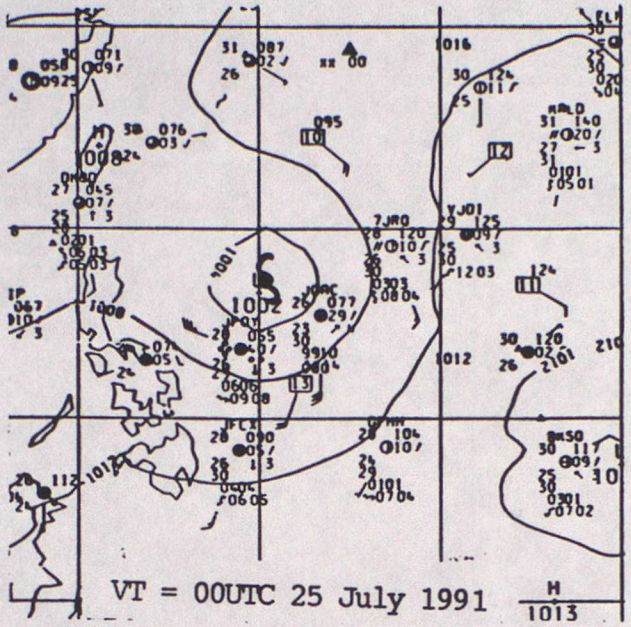


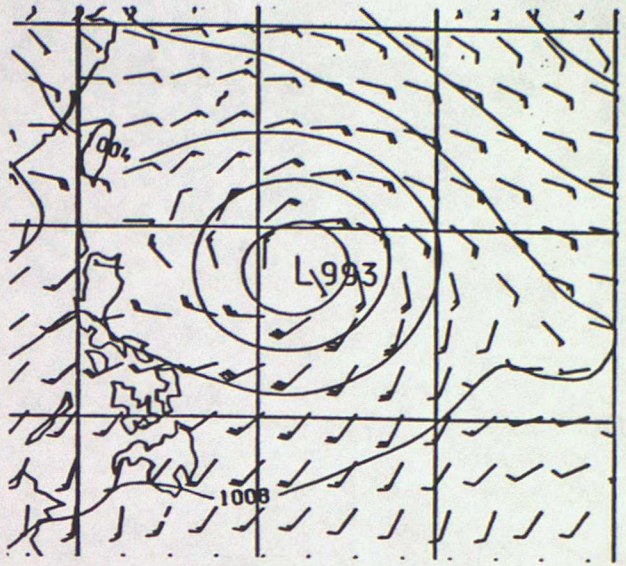
Figure 4. BRENDAN. Verification time VT = 00UTC 22 July 1991 First reported 00UTC 21 July 1991 (VT-24).

DATA DERIVED FROM CM OPD 1 MAY 1990- 30 JUN 1990 & PLOTTED BY BAND(SIGMA DTA)
MEAN AND SD OF OBS FOR MODEL DATA TYPE TMP DATA UNUSED:NONE
PLOT IS: TOP:IDENTIFIER,LEFT:MEAN OBS,RIGHT:SD OBS UNITS:(TENTHS) °K
VARIABLE:TEMP PRESSURE BAND: 700- 500MB ANALYSIS HOUR: 0

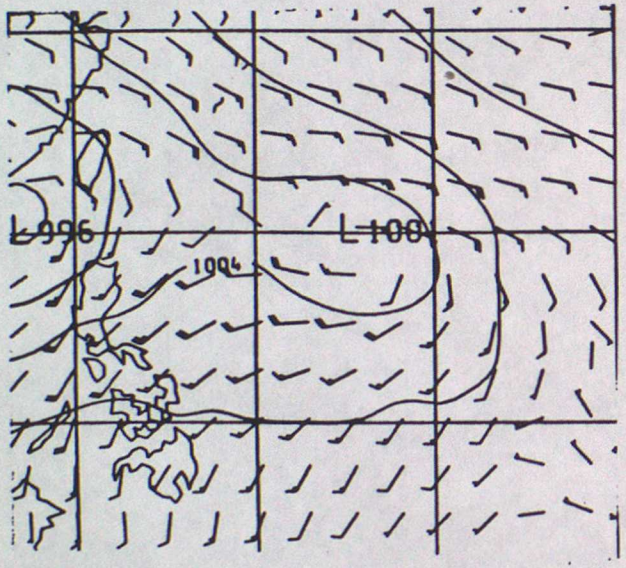




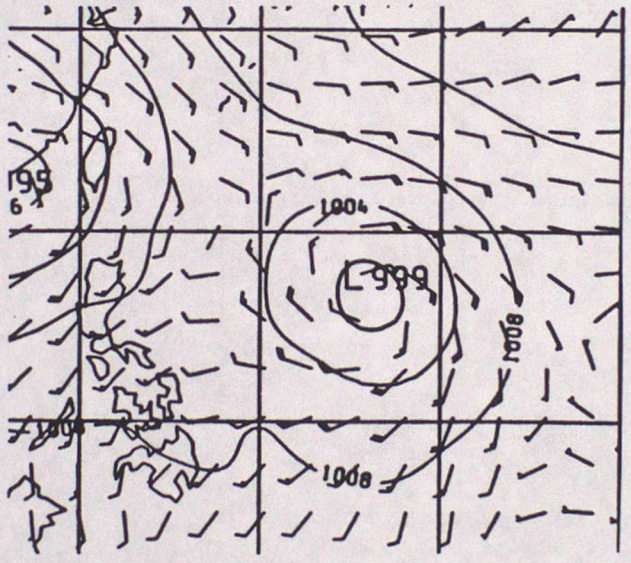




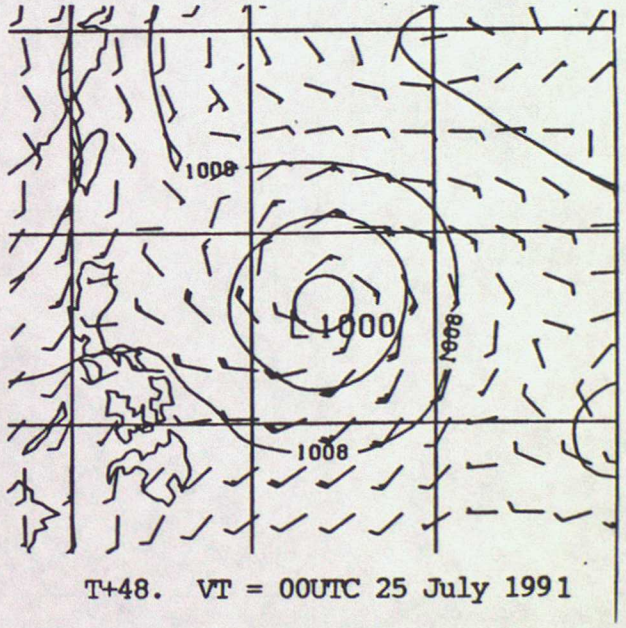
T+120. VT = 00UTC 25 July 1991



T+96. VT = 00UTC 25 July 1991



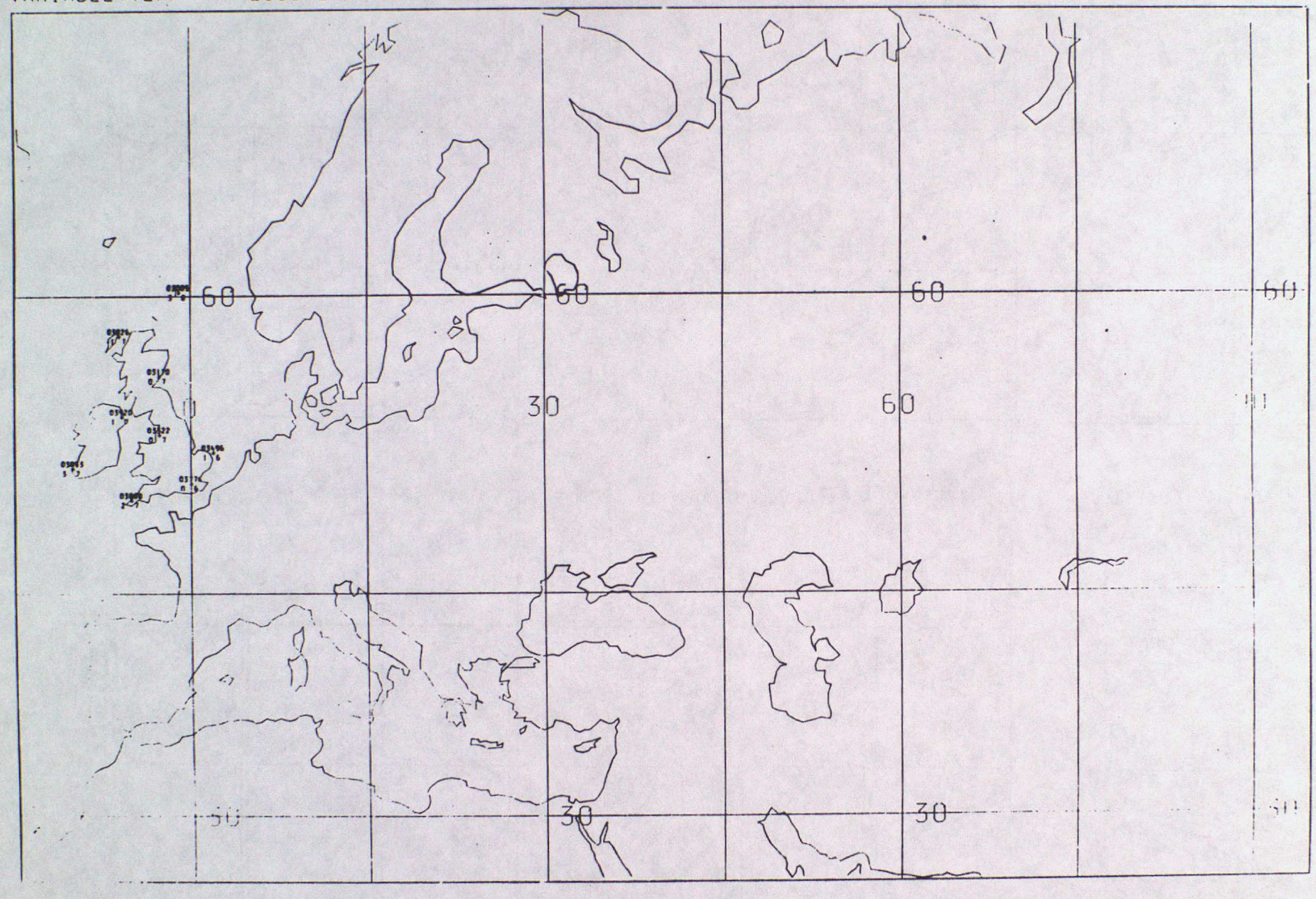
T+72. VT = 00UTC 25 July 1991

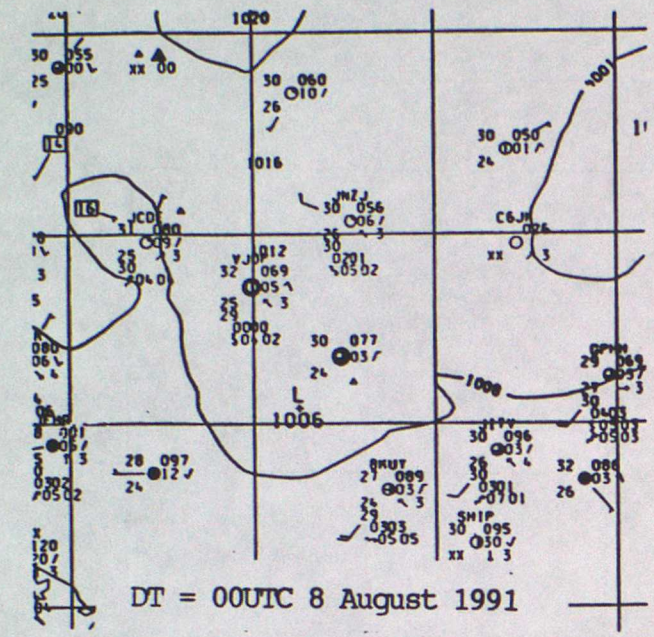


T+48. VT = 00UTC 25 July 1991

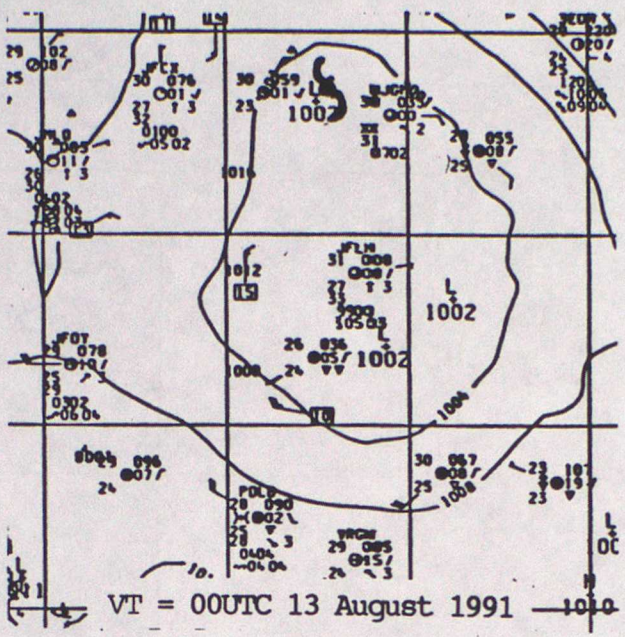
Figure 5. CAITLIN. Verification time VT = 00UTC 25 July 1991 First reported 12UTC 23 July 1991 (VT-36).

DATA DERIVED FROM CM OPD 1 MAY 1990- 30 JUN 1990 & PLOTTED BY BAND(SIGMA DTA)
MEAN AND RMS OF O-A DIFFERENCES FOR MODEL DATA TYPE TMP.DATA UNUSED:NONE
PLOT IS: TOP:IDENTIFIER.LEFT:MEAN O-A RIGHT: RMS O-A UNITS(TENTHS): K
VARIABLE:TEMP PRESSURE BAND: 700- 500MB ANALYSIS HOUR: 0

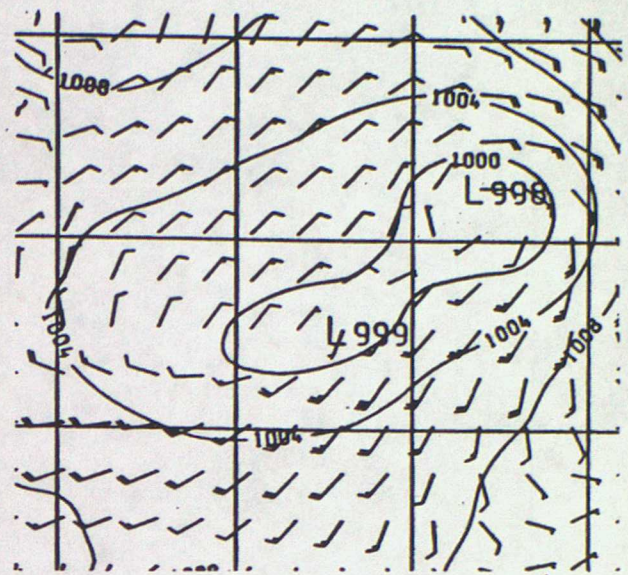




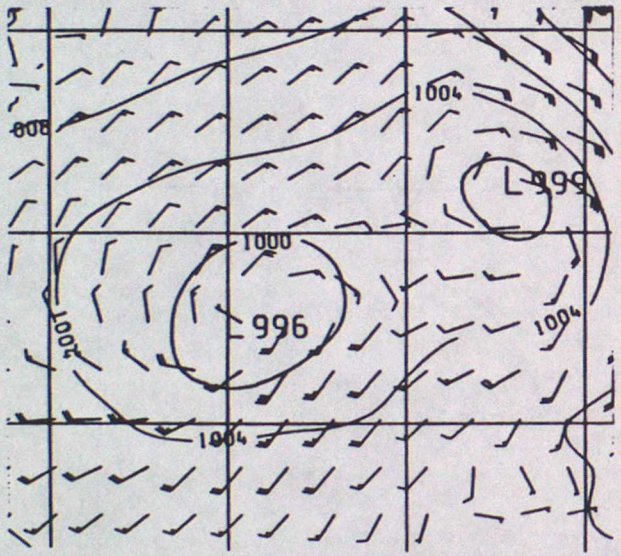
DT = 00UTC 8 August 1991



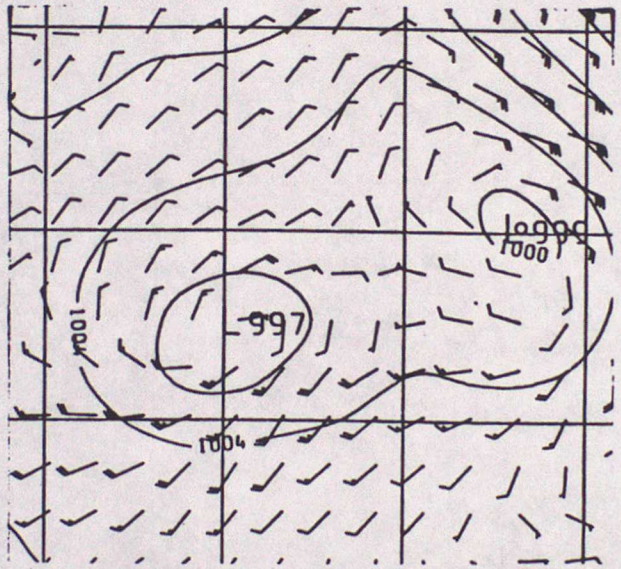
VT = 00UTC 13 August 1991



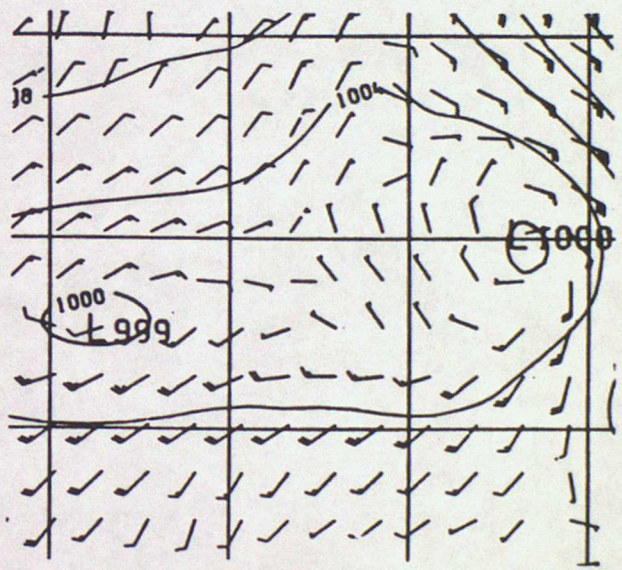
T+120. VT = 00UTC 13 August 1991



T+96. VT = 00UTC 13 August 1991



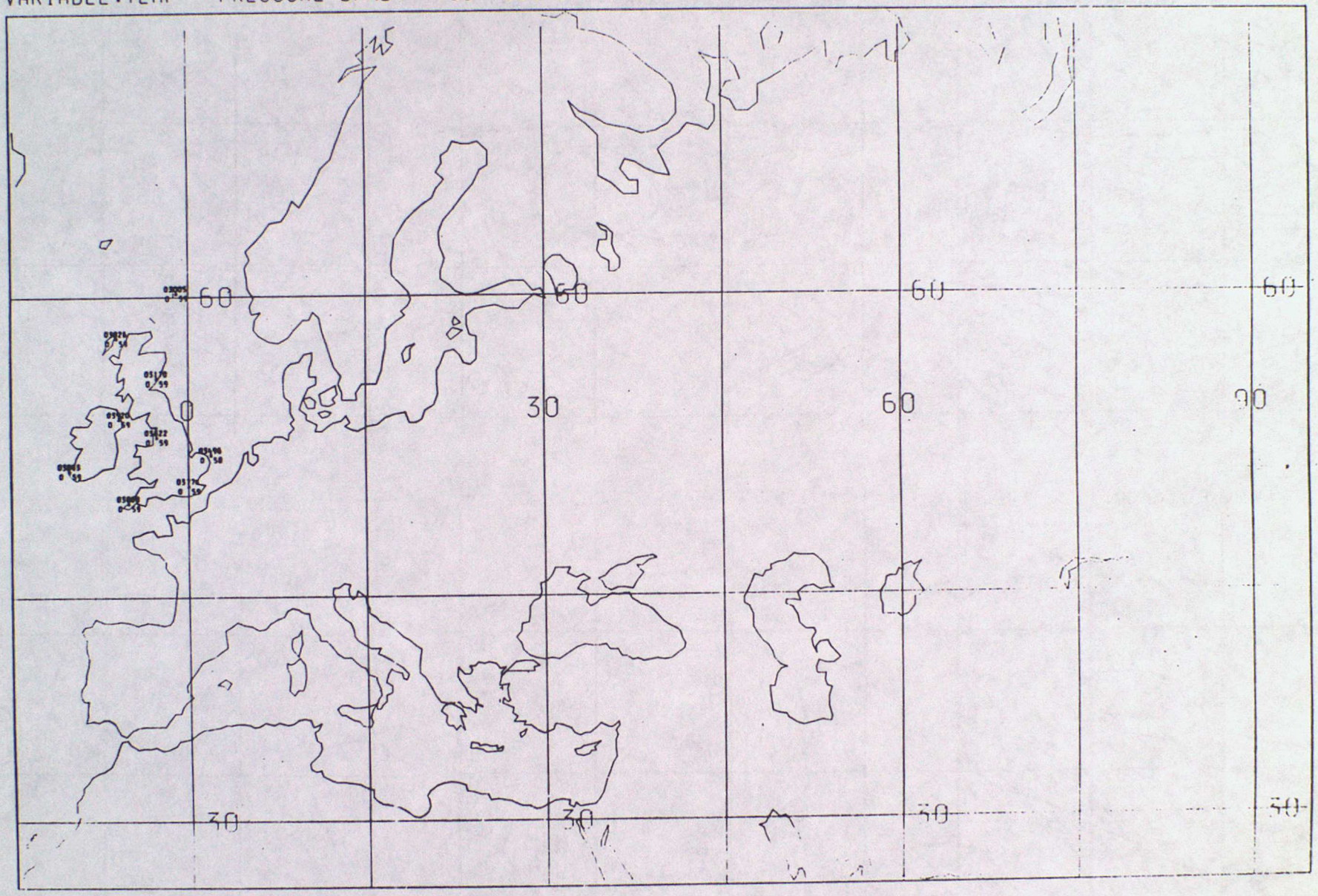
T+72. VT = 00UTC 13 August 1991

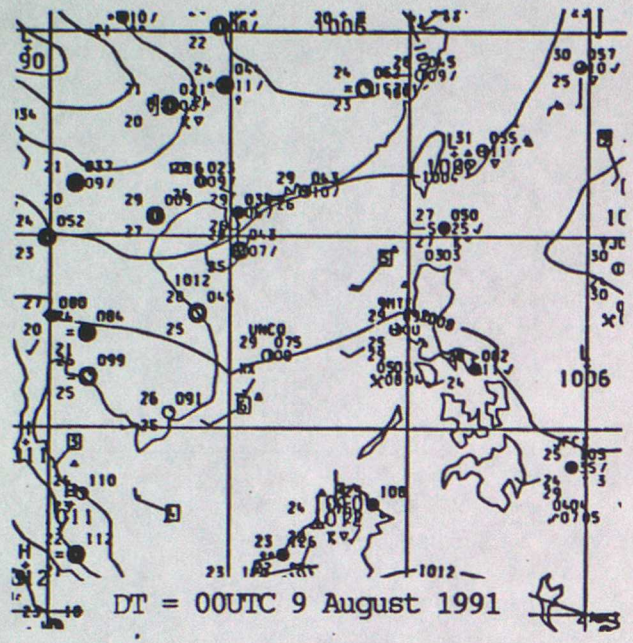


T+48. VT = 00UTC 13 August 1991

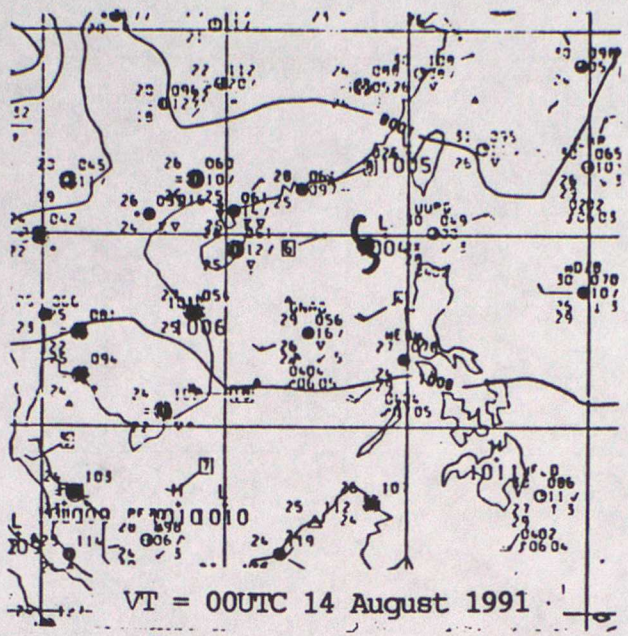
Figure 6. ELLIE. Verification time VT = 00UTC 13 August 1991. First reported 18UTC 10 August 1991 (VT-54).

DATA DERIVED FROM CM OPD 1 MAY 1990- 30 JUN 1990 & PLOTTED BY BAND(SIGMA DTA)
OBSERVATION AND FLAG COUNTS FOR MODEL DATA TYPE TMP.DATA UNUSED:NONE
PLOT IS: TOP:IDENTIFIER.LEFT:% FINAL FLG.RIGHT:N. OBS USED FOR STATISTICS
VARIABLE:TEMP PRESSURE BAND: 700- 500MB ANALYSIS HOUR: 0

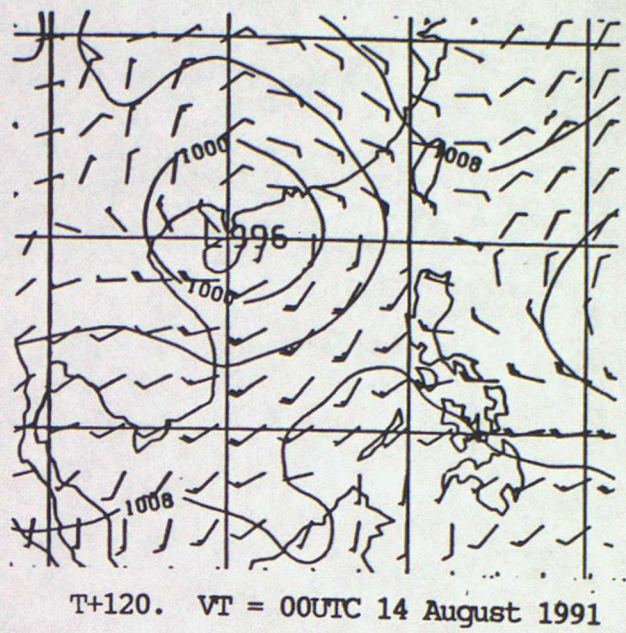




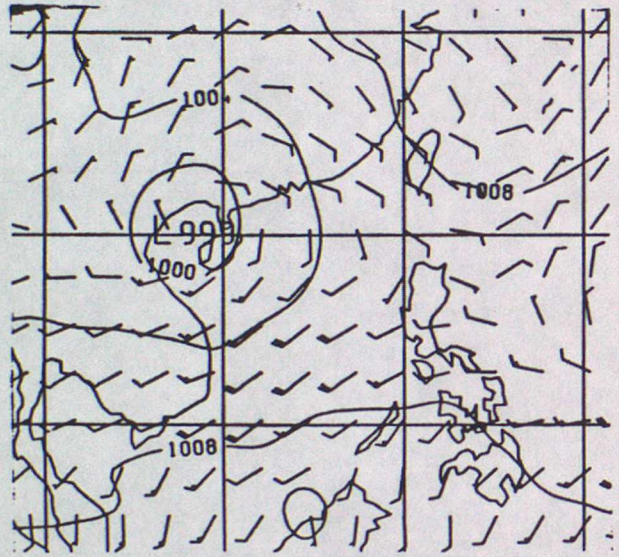
DT = 00UTC 9 August 1991



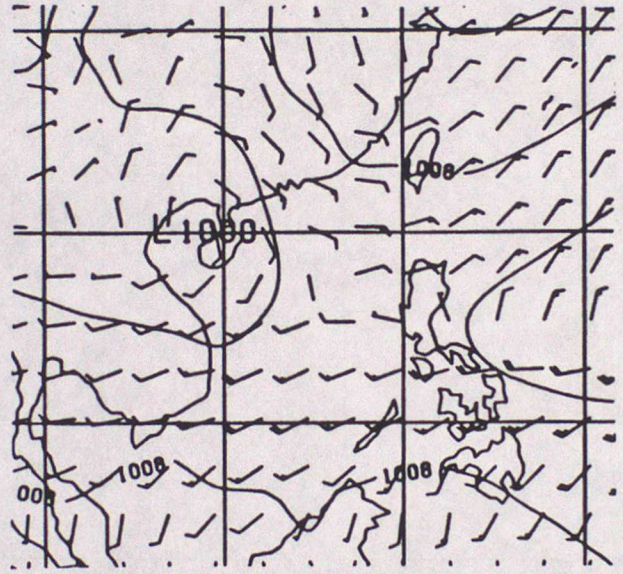
VT = 00UTC 14 August 1991



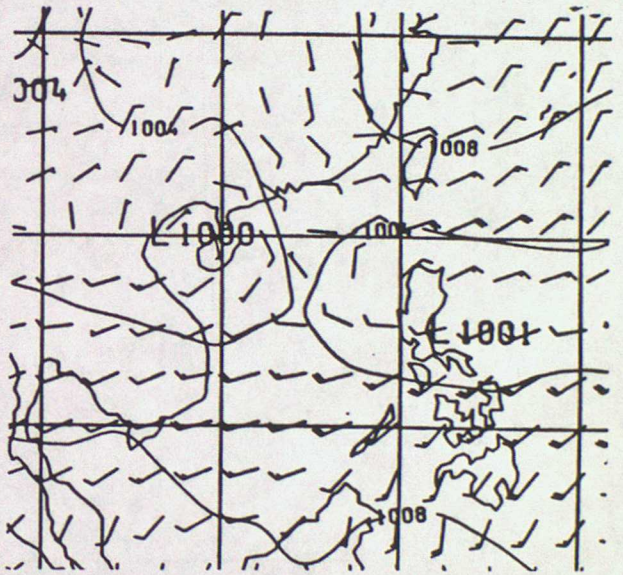
T+120. VT = 00UTC 14 August 1991



T+96. VT = 00UTC 14 August 1991



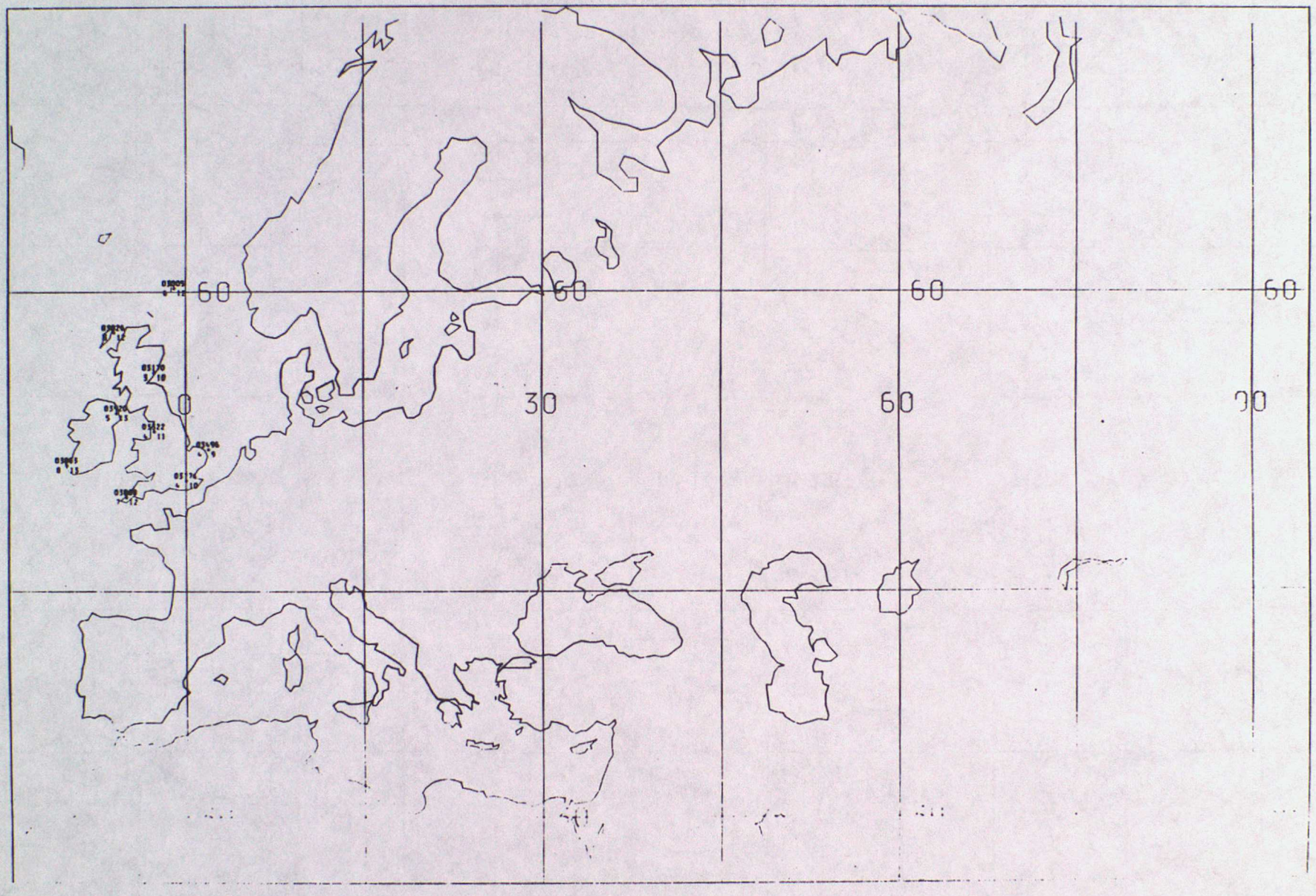
T+72. VT = 00UTC 14 August 1991

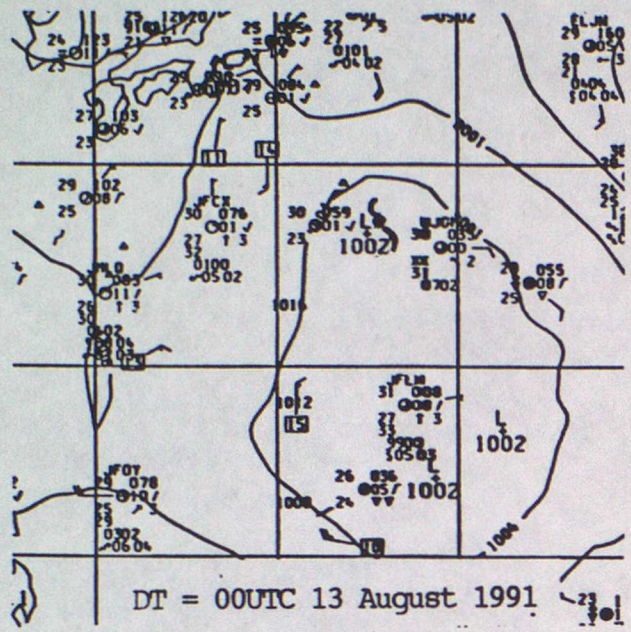


T+48. VT = 00UTC 14 August 1991

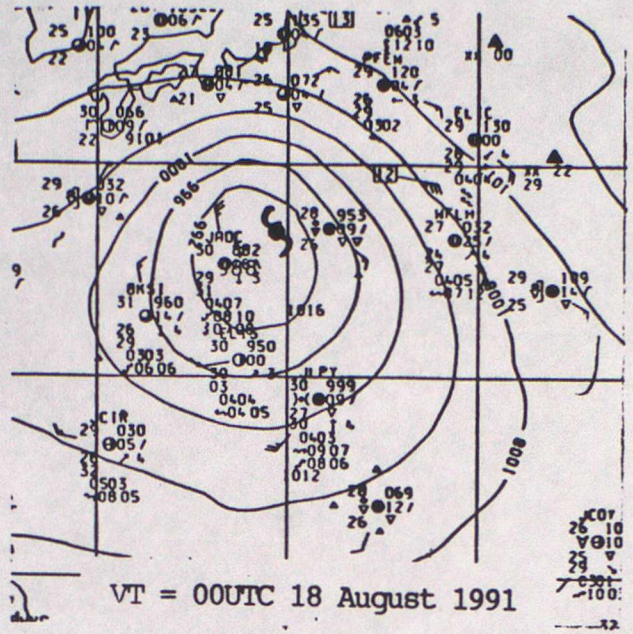
Figure 7. FRED. Verification time VT = 00UTC 14 August 1991. First reported 12UTC 11 August 1991 (VT-60).

DATA DERIVED FROM CM OPD 1 MAY 1990- 30 JUN 1990 & PLOTTED BY BAND(SIGMA DTA)
MEAN AND RMS OF O-B DIFFERENCES FOR MODEL DATA TYPE TMP.DATA UNUSED:NONE
PLOT IS: TOP:IDENTIFIER.LEFT:MEAN O-B RIGHT: RMS O-B UNITS(TENTHS): K
VARIABLE:TEMP PRESSURE BAND: 700- 500MB ANALYSIS HOUR: 0

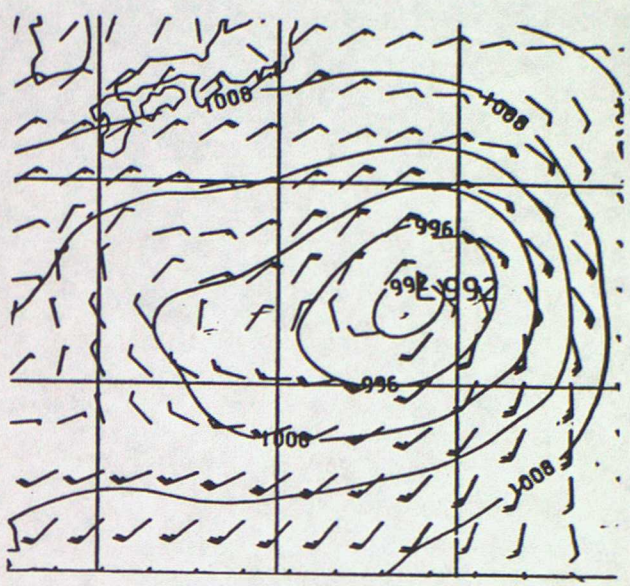




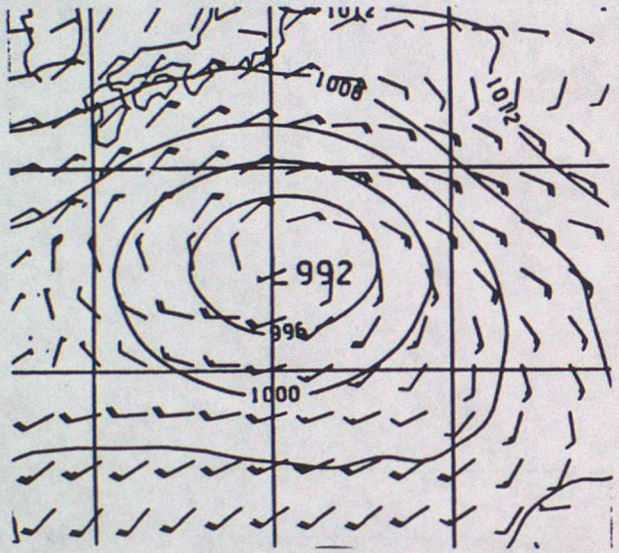
DT = 00UTC 13 August 1991



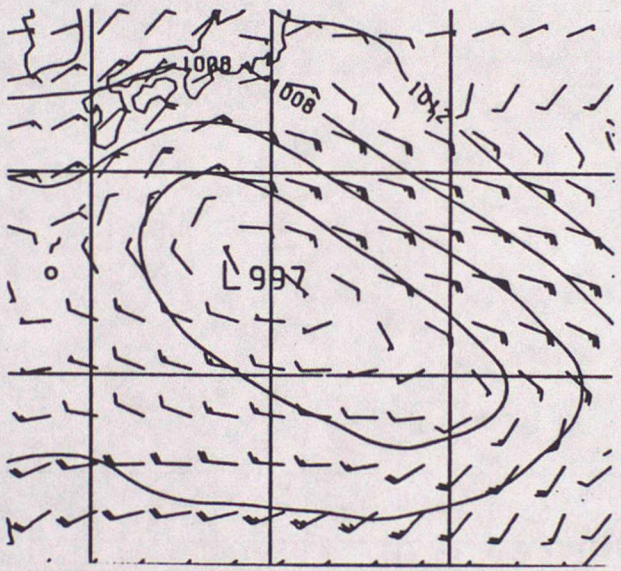
VT = 00UTC 18 August 1991



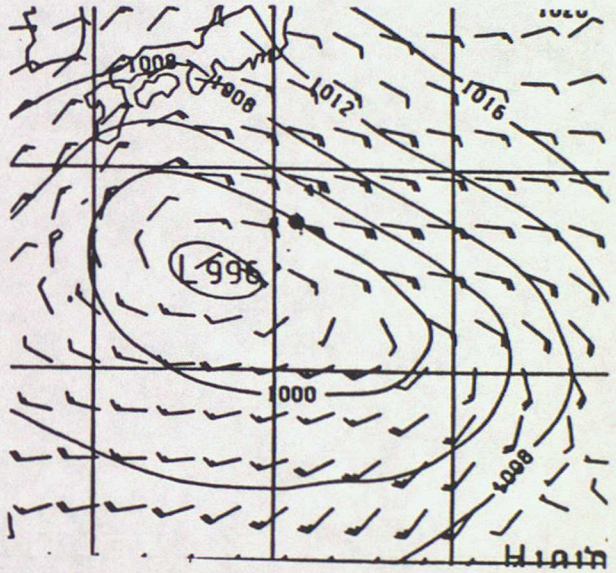
T+120. VT = 00UTC 18 August 1991



T+96. VT = 00UTC 18 August 1991



T+72. VT = 00UTC 18 August 1991

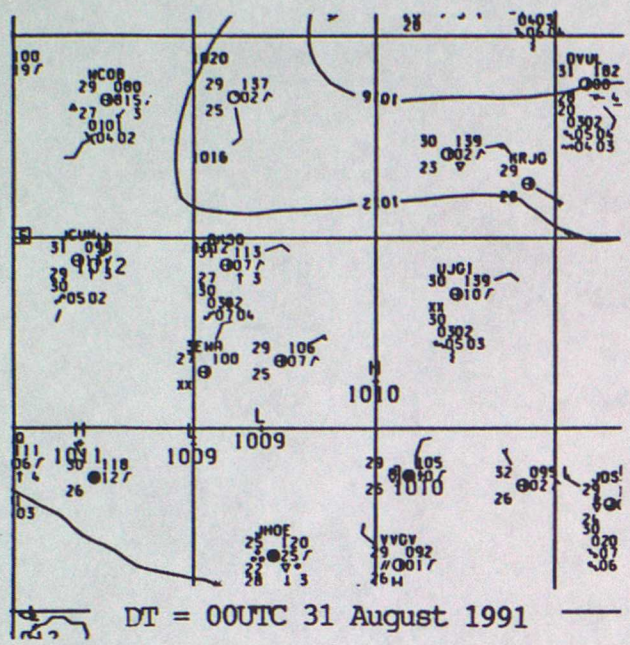


T+48. VT = 00UTC 18 August 1991

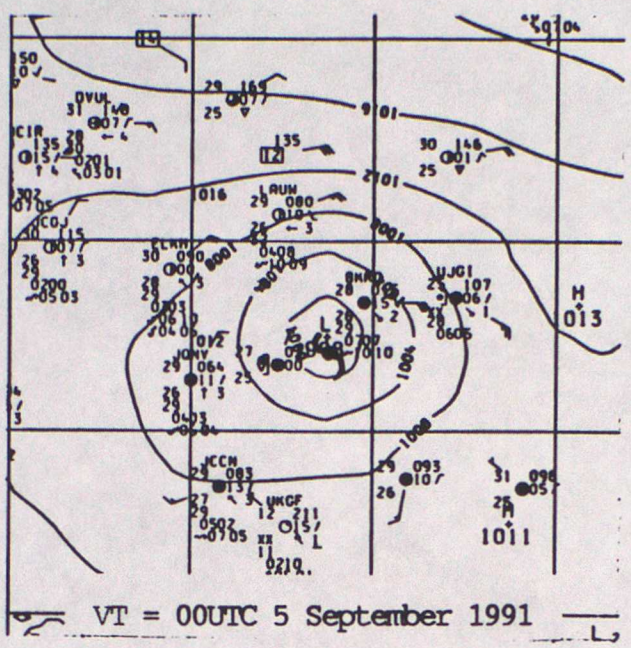
Figure 8. GLADYS. Verification time VT = 00UTC 18 August 1991. First reported 00UTC 16 August 1991 (VT-48).

OVERFLOW PLOTS FOR DATA DERIVED FROM CM OPD 1 MAY 1990- 31 JUN 1990 & PLOTTED BY BAND(SIGMA DTA)
OBSERVATION AND FLAG COUNTS FOR MODEL DATA TYPE TMP.DATA UNUSED:FINAL FLAGS
PLOT IS: TOP:IDENTIFIER.LEFT:% FINAL FLG.RIGHT:N. OBS USED FOR STATISTICS
VARIABLE:VT WD PRESSURE BAND: 700- 500MB ANALYSIS HOUR: ALL

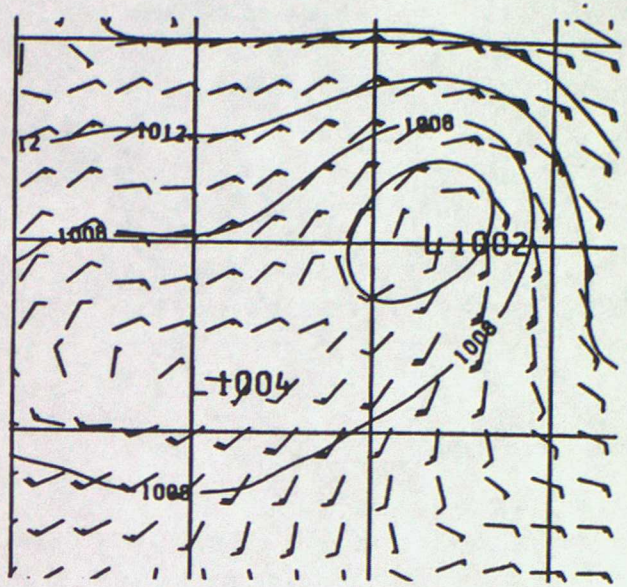
53.6 -2.9	51.1 -0.2	50.8 9.4	54.4 10.2	52.8 9.9	52.7 7.3	52.5 13.4	51.4 7.8	51.1 8.3	49.7 7.3	48.3 11.6	48.0 8.9	50.0 14.5	46.2 20.6	46.7 11.6	52.4 26.3	54.0 9.7	56.9 20.2
05327 0 476	05774 0 482	06476 0 222	10004 0 411	10238 0 373	10304 0 100	10304 0 215	10410 0 465	10437 0 306	10410 0 332	10060 0 440	10021 0 407	11520 0 471	19100 0 72	19144 0 91	40295 0 75	60875 0 87	60715 1 141



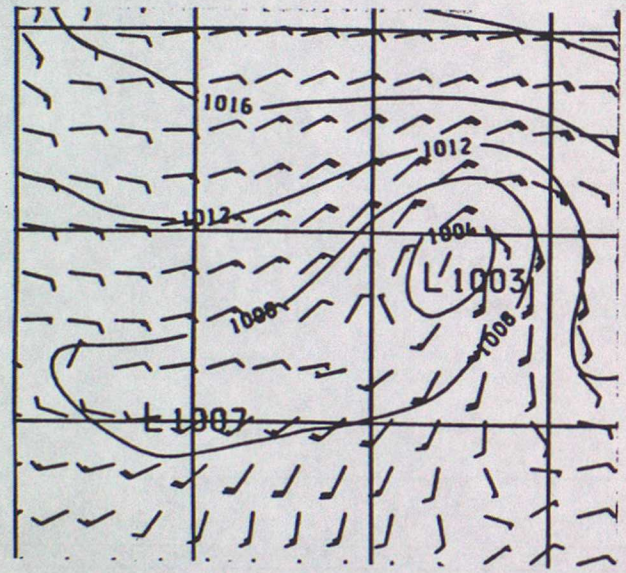
DT = 00UTC 31 August 1991



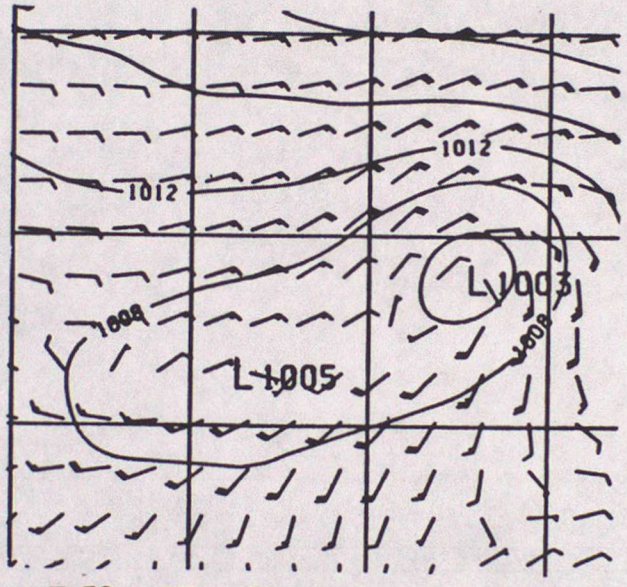
VT = 00UTC 5 September 1991



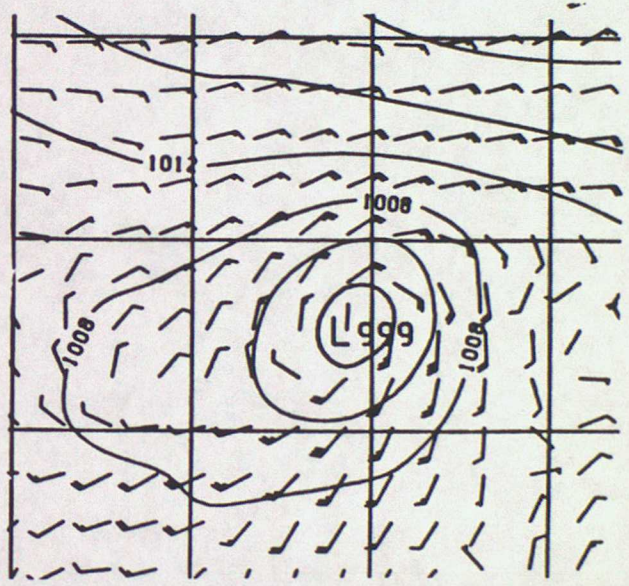
T+120. VT = 00UTC 5 September 1991



T+96. VT = 00UTC 5 September 1991



T+72. VT = 00UTC 5 September 1991

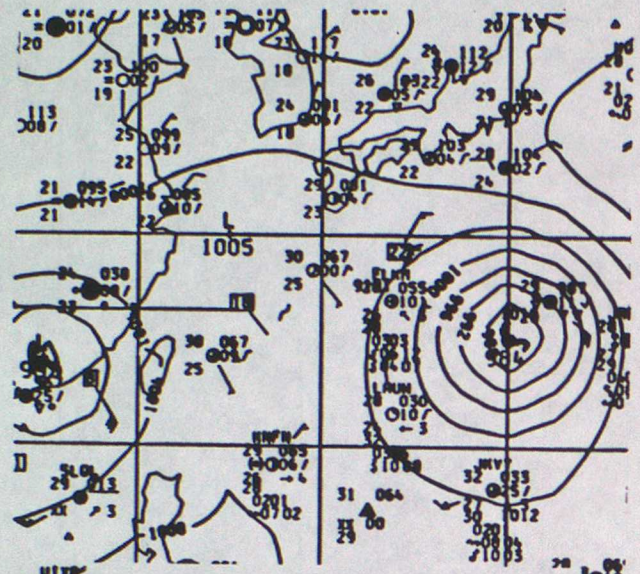


T+48. VT = 00UTC 5 September 1991

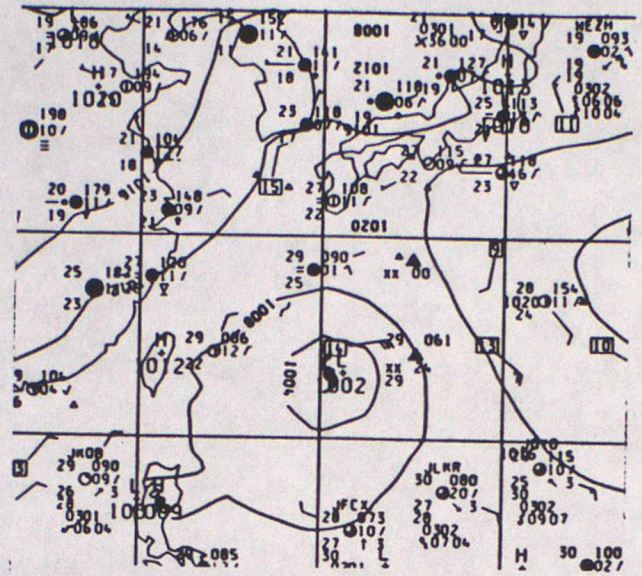
Figure 9. IVY. Verification time VT = 00UTC 5 September 1991. First reported 12UTC 2 September 1991 (VT-60).

OVERFLOW PLOTS FOR DATA DERIVED FROM CM OPD 1 MAY 1990- 31 JUN 1990 & PLOTTED BY BAND(SIGMA DTA)
MEAN AND RMS OF O-B DIFFERENCES FOR MODEL DATA TYPE TMP.DATA UNUSED:FINAL FLAGS
PLOT IS: TOP:IDENTIFIER.LEFT:MEAN O-B RIGHT: RMS O-B UNITS(TENTHS):KTS
VARIABLE:VT WD PRESSURE BAND: 400- 150MB ANALYSIS HOUR: ALL

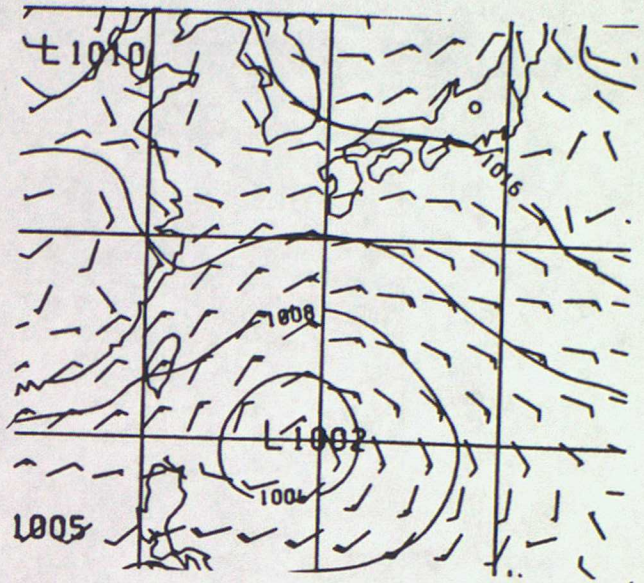
55.6 -2.9	51.1 -0.2	50.0 5.4	54.4 10.2	52.0 9.9	52.7 7.3	52.5 13.4	51.4 7.0	51.1 9.3	49.7 7.3	48.3 11.6	48.0 8.9	50.0 14.5	44.7 11.6	35.0 10.2
03322 0 81	03774 0 79	04476 0 90	10846 0 74	10230 0 72	10304 0 70	10304 0 79	10410 0 77	10427 0 73	10410 0 97	10060 0 81	10521 0 89	11520 0 76	10144 0 94	09715 0 123



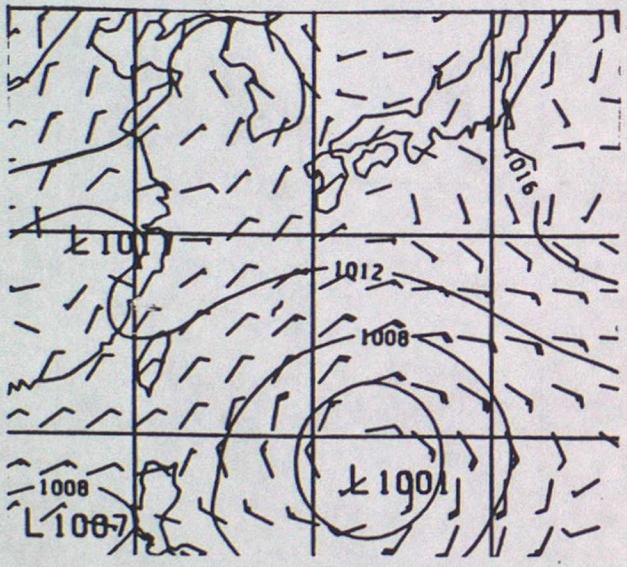
DT = 00UTC 7 September 1991



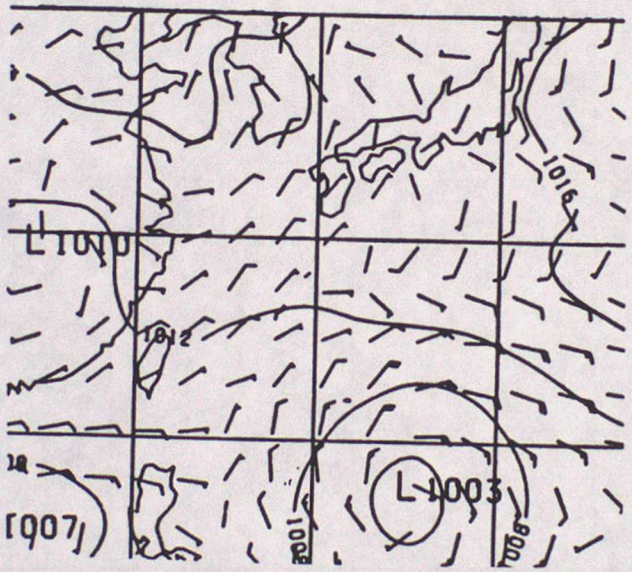
VT = 00UTC 12 September 1991



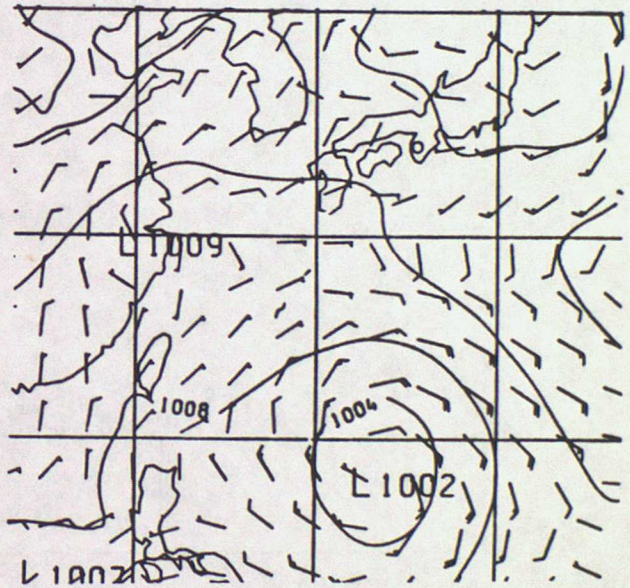
T+120. VT = 00UTC 12 September 1991



T+96. VT = 00UTC 12 September 1991



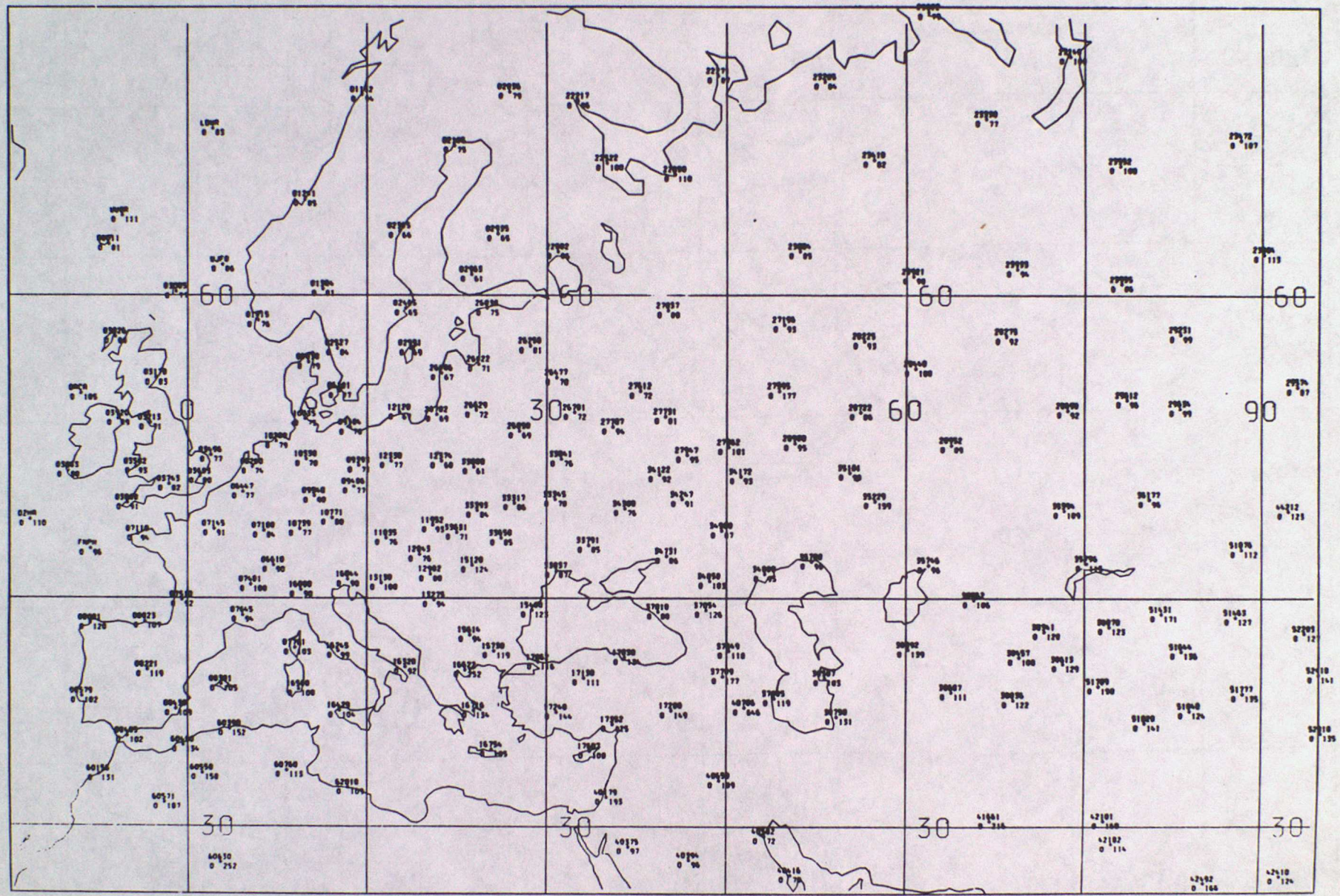
T+72. VT = 00UTC 12 September 1991

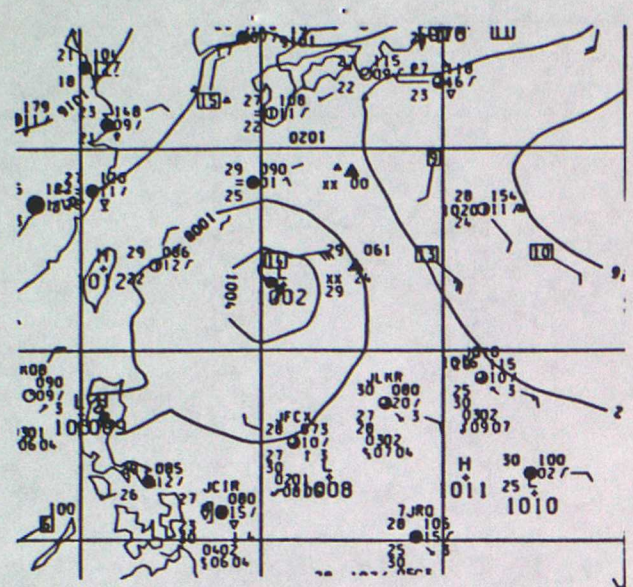


T+48. VT = 00UTC 12 September 1991

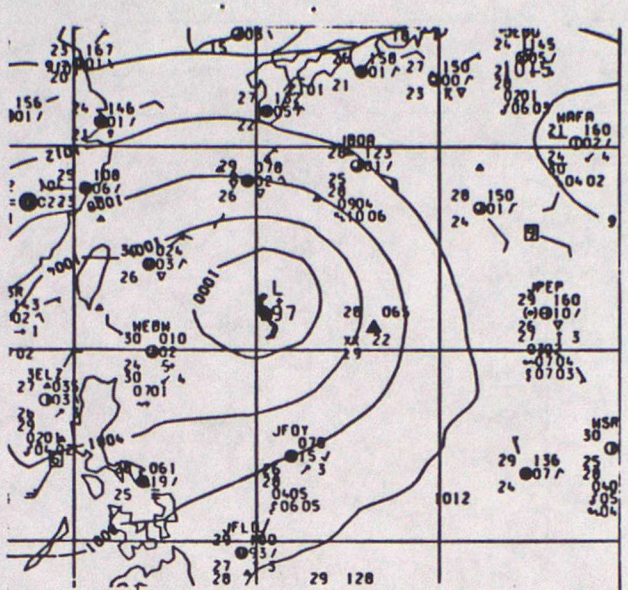
Figure 10. KINNA. Verification time VT = 00UTC 12 September 1991. First reported 12UTC 10 September 1991 (VT-36).

DATA DERIVED FROM CM OPD 1 MAY 1990- 31 JUN 1990 & PLOTTED BY BAND(SIGMA DTA)
MEAN AND RMS OF O-B DIFFERENCES FOR MODEL DATA TYPE TMP.DATA UNUSED:FINAL FLAGS
PLOT IS: TOP:IDENTIFIER.LEFT:MEAN O-B RIGHT: RMS O-B UNITS(TENTHS):KTS
VARIABLE:VT WD PRESSURE BAND: 400- 150MB ANALYSIS HOUR: ALL

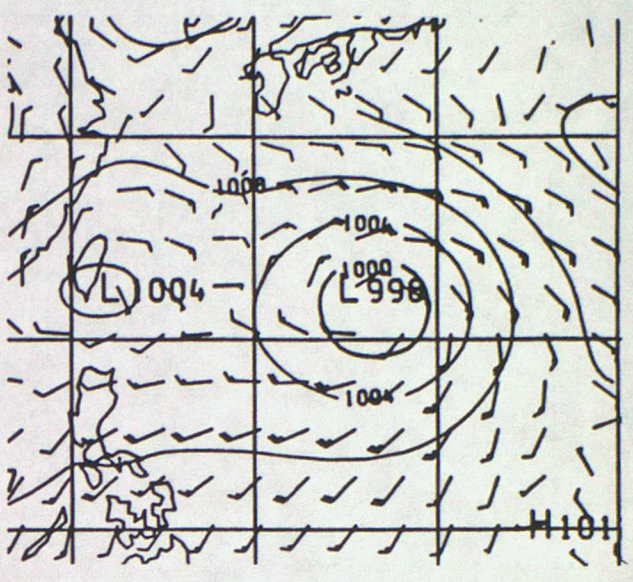




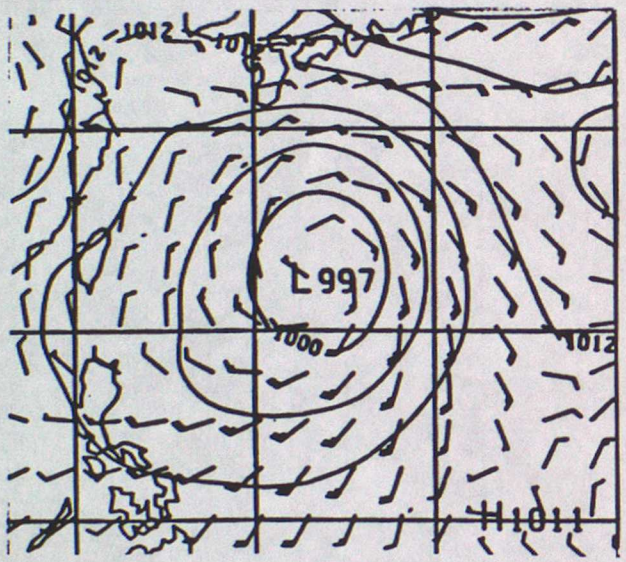
DT = 00UTC 12 September 1991



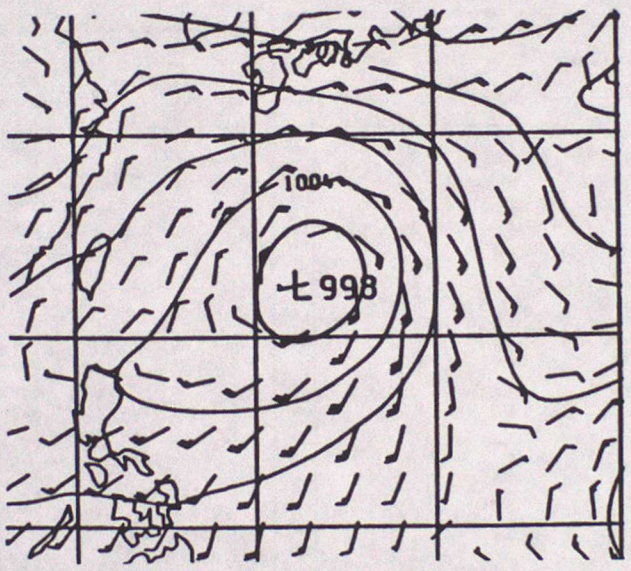
VT = 00UTC 17 September 1991



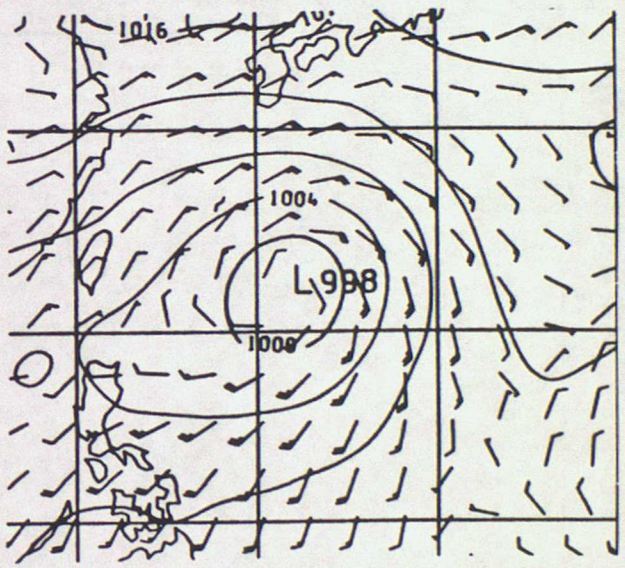
T+120. VT = 00UTC 17 September 1991



T+96. VT = 00UTC 17 September 1991



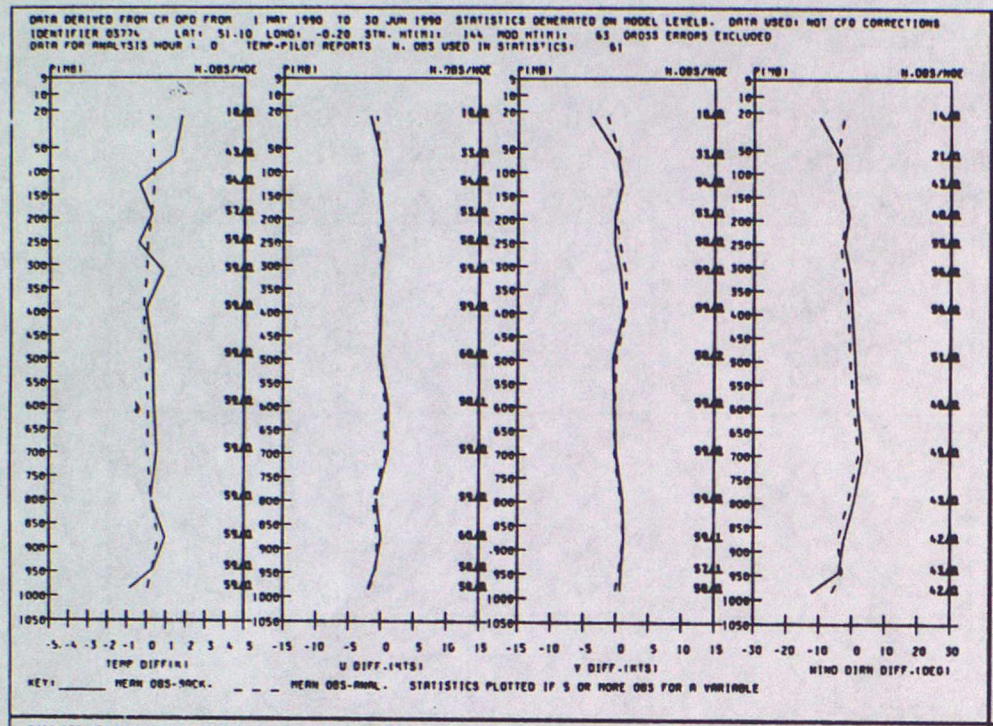
T+72. VT = 00UTC 17 September 1991

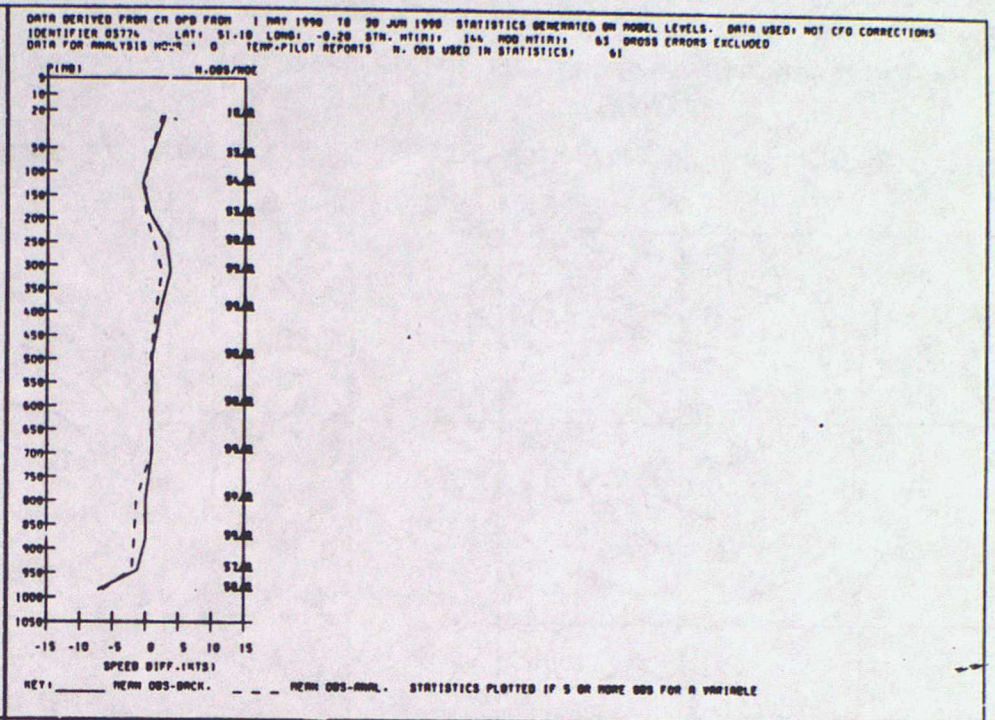


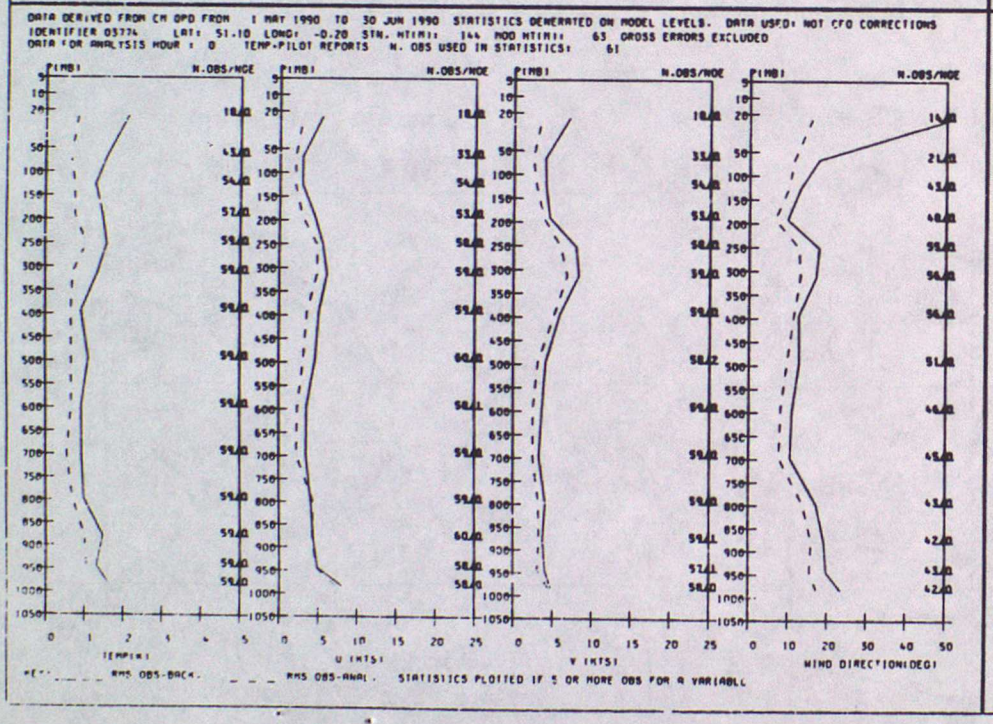
T+48. VT = 00UTC 17 September 1991

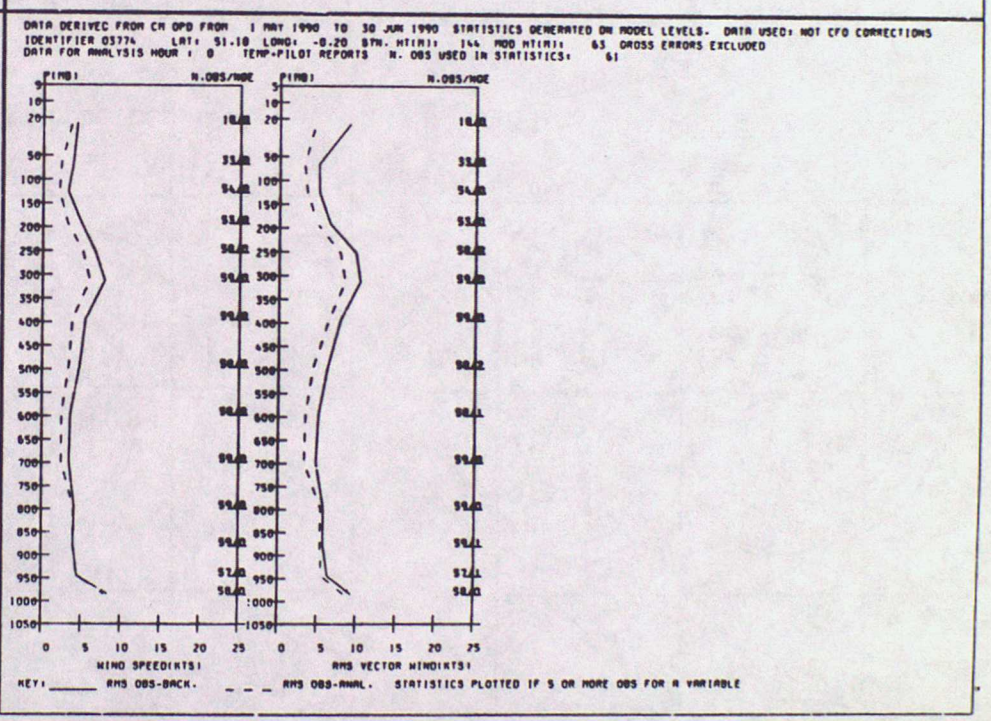
Figure 11. LUKE. Verification time VT = 00UTC 17 September 1991. First reported 18UTC 14 September 1991 (VT-54).

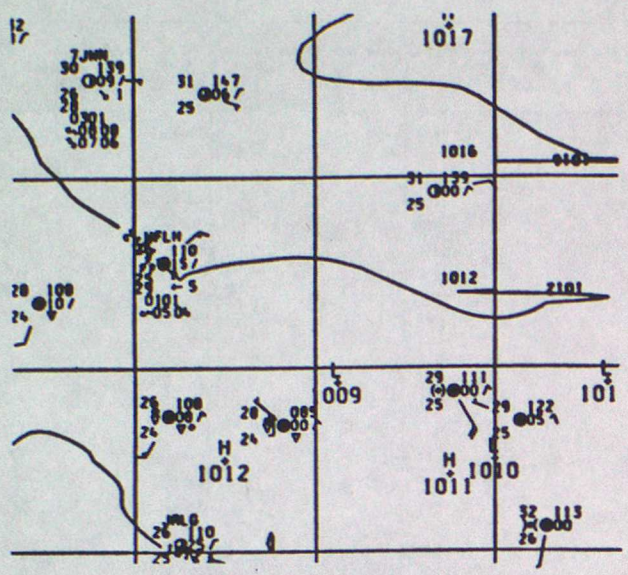
UAE2


DATA DERIVED FROM CM OPD FROM 1 MAY 1990 TO 30 JUN 1990 STATISTICS GENERATED ON MODEL LEVELS. DATA USED: NOT CFO CORRECTIONS
IDENTIFIER 03774 LAT: 51.10 LONG: -0.20 STN. HT(M): 144 ANOM HT(M): 63 GROSS ERRORS EXCLUDED
DATA FOR ANALYSIS HOUR : 0 TEMP+PILOT REPORTS N. OBS USED IN STATISTICS: 61
P(MB)
N.OBS/MDE
TEMP DIFF(K)
U DIFF.(KTS)
V DIFF.(KTS)
WIND DIRN DIFF.(DEG)
KEY: _____ MEAN OBS-BACK. _ _ _ MEAN OBS-ANAL. STATISTICS PLOTTED IF 5 OR MORE OBS FOR A VARIABLE

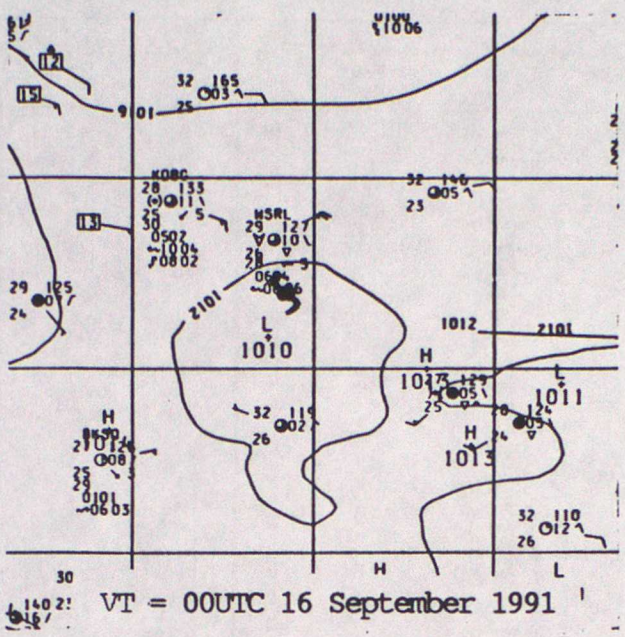

DATA DERIVED FROM CM OPD FROM 1 MAY 1990 TO 30 JUN 1990 STATISTICS GENERATED ON MODEL LEVELS. DATA USED: NOT CFO CORRECTIONS
IDENTIFIER 03774 LAT: 51.10 LONG: -0.20 STN. HT(M): 144 ANOM HT(M): 63 GROSS ERRORS EXCLUDED
DATA FOR ANALYSIS HOUR : 0 TEMP+PILOT REPORTS N. OBS USED IN STATISTICS: 61
P(MB)
N.OBS/MDE
SPEED DIFF.(KTS)
KEY: _____ MEAN OBS-BACK. _ _ _ MEAN OBS-ANAL. STATISTICS PLOTTED IF 5 OR MORE OBS FOR A VARIABLE


DATA DERIVED FROM CM OPD FROM 1 MAY 1990 TO 30 JUN 1990 STATISTICS GENERATED ON MODEL LEVELS. DATA USED: NOT CFO CORRECTIONS
IDENTIFIER 03774 LAT: 51.10 LONG: -0.20 STN. HT(M): 144 ANOM HT(M): 63 GROSS ERRORS EXCLUDED
DATA FOR ANALYSIS HOUR : 0 TEMP+PILOT REPORTS N. OBS USED IN STATISTICS: 61
P(MB)
N.OBS/MDE
TEMP(K)
U (KTS)
V (KTS)
WIND DIRECTION(DEG)
KEY: _____ RMS OBS-BACK. _ _ _ RMS OBS-ANAL. STATISTICS PLOTTED IF 5 OR MORE OBS FOR A VARIABLE

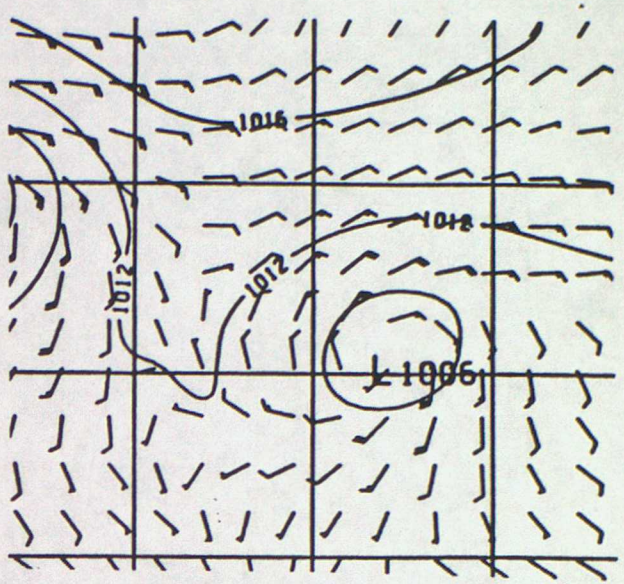

DATA DERIVED FROM CM OPD FROM 1 MAY 1990 TO 30 JUN 1990 STATISTICS GENERATED ON MODEL LEVELS. DATA USED: NOT CFO CORRECTIONS
IDENTIFIER 03774 LAT: 51.10 LONG: -0.20 STN. HT(M): 144 ANOM HT(M): 63 GROSS ERRORS EXCLUDED
DATA FOR ANALYSIS HOUR : 0 TEMP+PILOT REPORTS N. OBS USED IN STATISTICS: 61
P(MB)
N.OBS/MDE
WIND SPEED(KTS)
RMS VECTOR WIND(KTS)
KEY: _____ RMS OBS-BACK. _ _ _ RMS OBS-ANAL. STATISTICS PLOTTED IF 5 OR MORE OBS FOR A VARIABLE



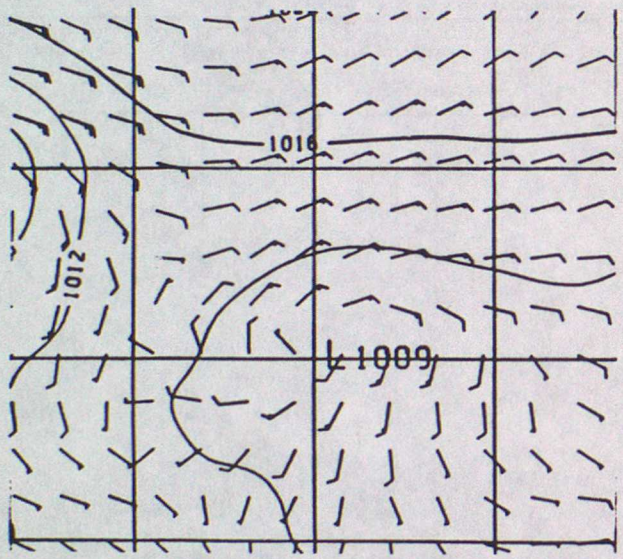
DT = 00UTC 11 September 1991



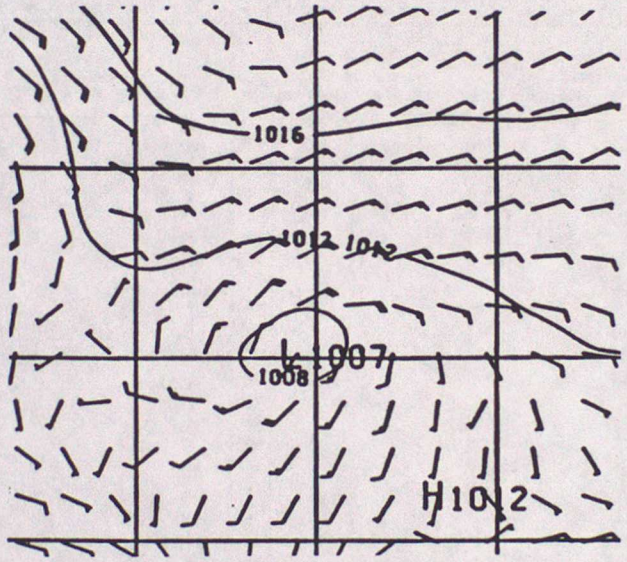
VT = 00UTC 16 September 1991



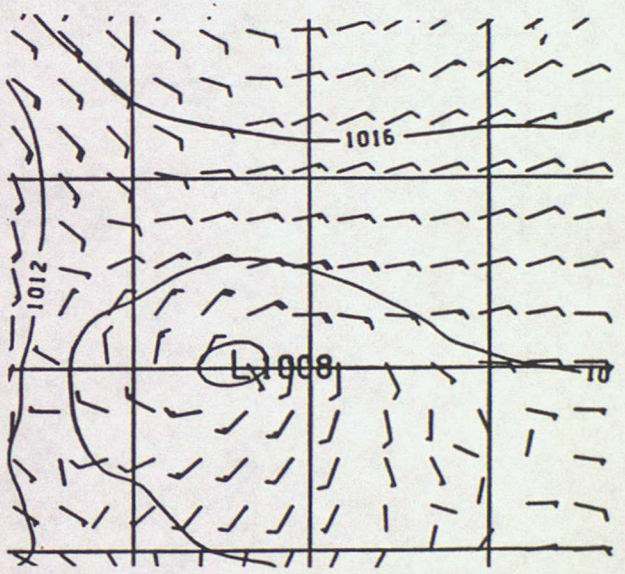
T+120. VT = 00UTC 16 September 1991



T+96. VT = 00UTC 16 September 1991

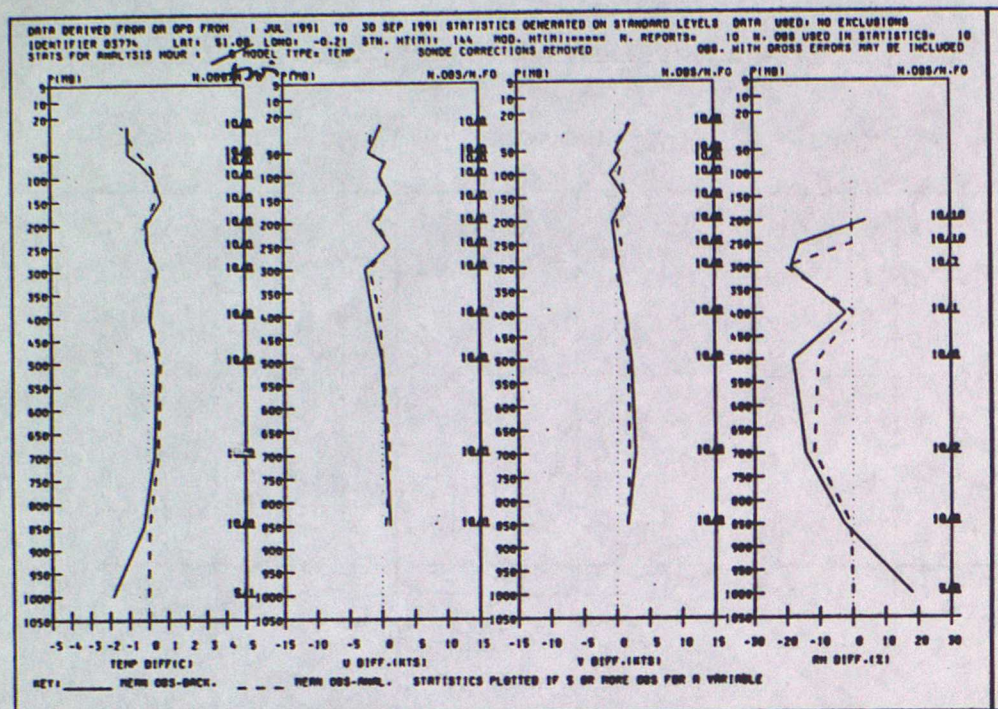


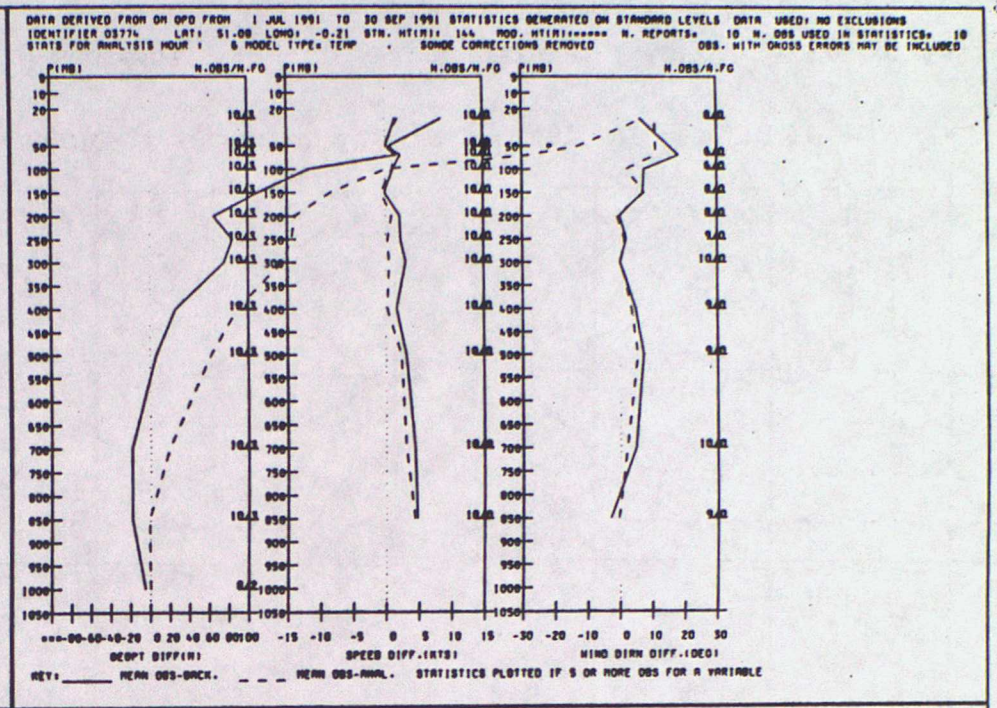
T+72. VT = 00UTC 16 September 1991

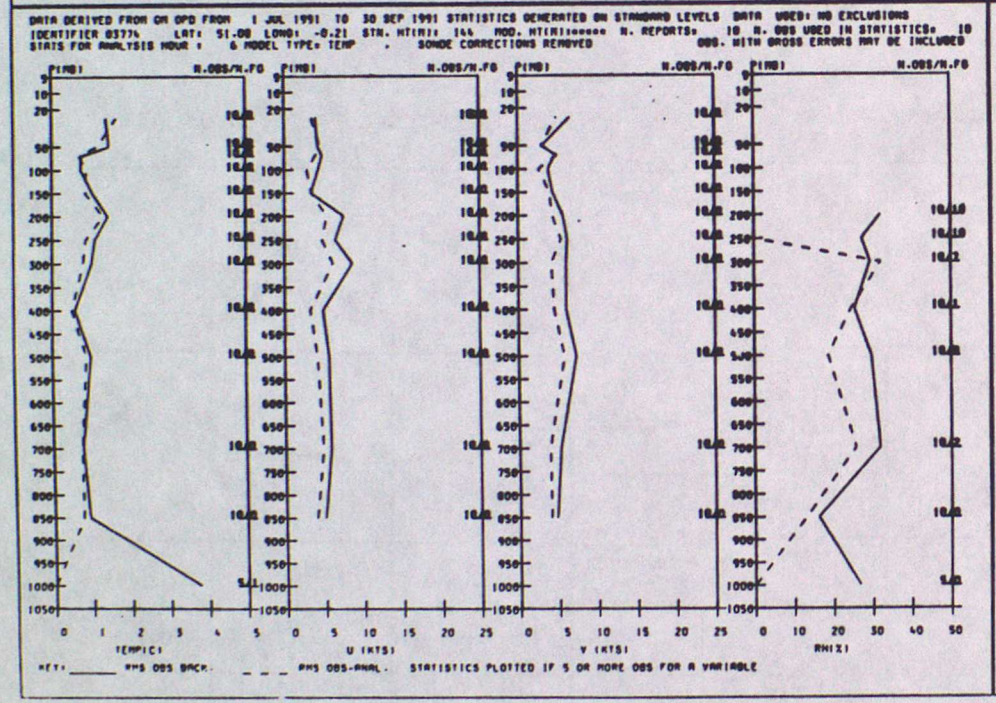


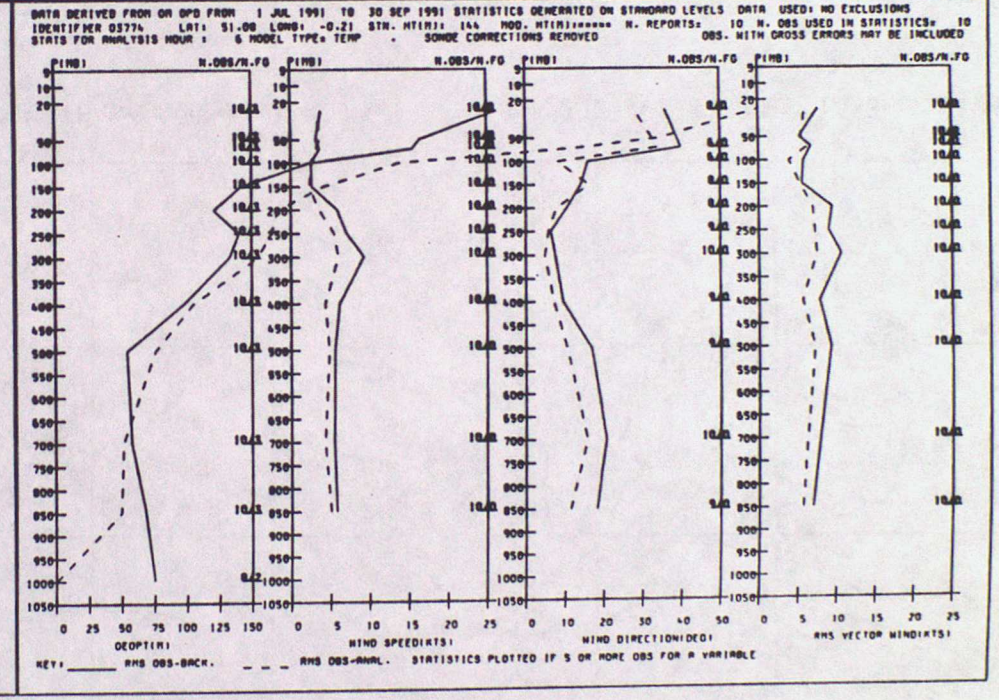
T+48. VT = 00UTC 16 September 1991

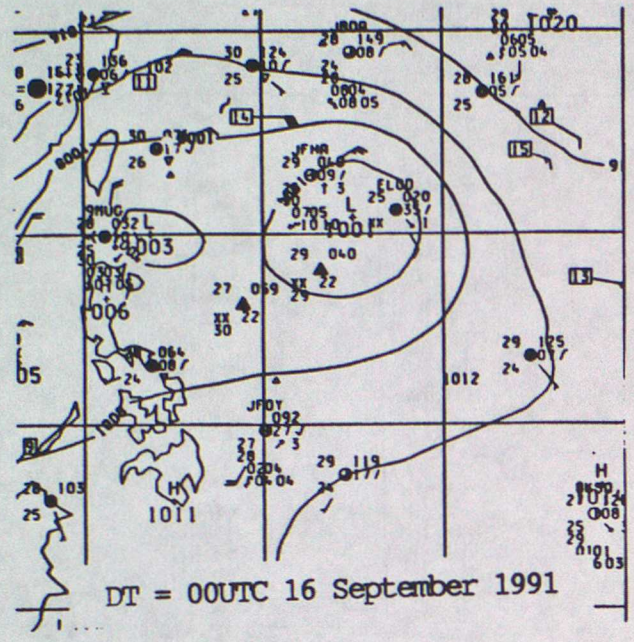
Figure 12. MIREILLE. Verification time VT = 00UTC 16 September 1991. First reported 00UTC 16 September 1991 (VT-0).


DATA DERIVED FROM OM GPD FROM 1 JUL 1991 TO 30 SEP 1991 STATISTICS GENERATED ON STANDARD LEVELS DATA USED: NO EXCLUSIONS
IDENTIFIER 03774 LAT: 51.08 LONG: -0.21 STN. HT(M): 144 MOD. HT(M):***** N. REPORTS= 10 N. OBS USED IN STATISTICS= 10
STATS FOR ANALYSIS HOUR : 6 MODEL TYPE= TEMP . SONDE CORRECTIONS REMOVED OBS. WITH GROSS ERRORS MAY BE INCLUDED
P(MB) N.OBS/M.FG
TEMP DIFF(C)
U DIFF.(KTS)
V DIFF.(KTS)
RH DIFF.(%)
KEY: _____ MEAN OBS-BACK. _ _ _ MEAN OBS-ANAL. STATISTICS PLOTTED IF 5 OR MORE OBS FOR A VARIABLE

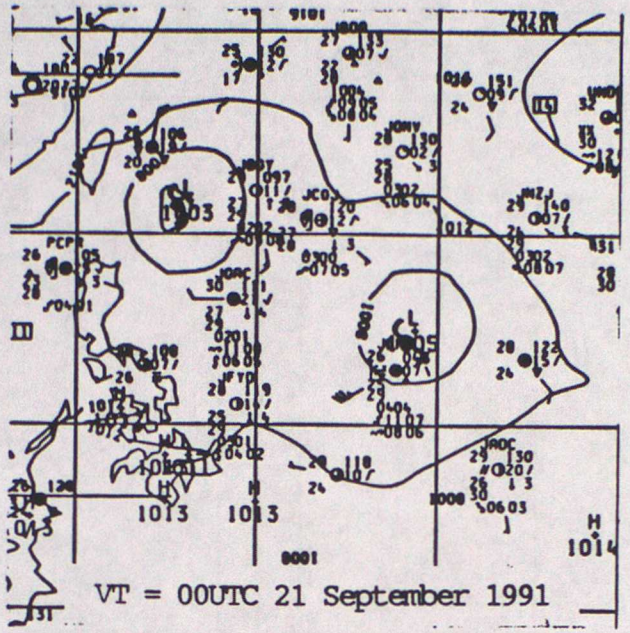

DATA DERIVED FROM OM GPD FROM 1 JUL 1991 TO 30 SEP 1991 STATISTICS GENERATED ON STANDARD LEVELS DATA USED: NO EXCLUSIONS
IDENTIFIER 03774 LAT: 51.08 LONG: -0.21 STN. HT(M): 144 MOD. HT(M):***** N. REPORTS= 10 N. OBS USED IN STATISTICS= 10
STATS FOR ANALYSIS HOUR : 6 MODEL TYPE= TEMP . SONDE CORRECTIONS REMOVED OBS. WITH GROSS ERRORS MAY BE INCLUDED
P(MB) N.OBS/M.FG
DEWPT DIFF(K)
SPEED DIFF.(KTS)
WIND DIRN DIFF.(DEG)
KEY: _____ MEAN OBS-BACK. _ _ _ MEAN OBS-ANAL. STATISTICS PLOTTED IF 5 OR MORE OBS FOR A VARIABLE


DATA DERIVED FROM OM GPD FROM 1 JUL 1991 TO 30 SEP 1991 STATISTICS GENERATED ON STANDARD LEVELS DATA USED: NO EXCLUSIONS
IDENTIFIER 03774 LAT: 51.08 LONG: -0.21 STN. HT(M): 144 MOD. HT(M):***** N. REPORTS= 10 N. OBS USED IN STATISTICS= 10
STATS FOR ANALYSIS HOUR : 6 MODEL TYPE= TEMP . SONDE CORRECTIONS REMOVED OBS. WITH GROSS ERRORS MAY BE INCLUDED
P(MB) N.OBS/M.FG
TEMP(C)
U (KTS)
V (KTS)
RH(%)
KEY: _____ RMS OBS-BACK. _ _ _ RMS OBS-ANAL. STATISTICS PLOTTED IF 5 OR MORE OBS FOR A VARIABLE

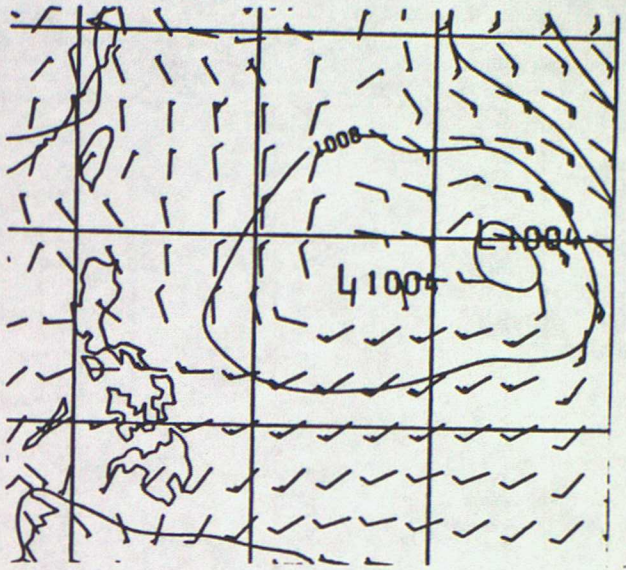

DATA DERIVED FROM OM GPD FROM 1 JUL 1991 TO 30 SEP 1991 STATISTICS GENERATED ON STANDARD LEVELS DATA USED: NO EXCLUSIONS
IDENTIFIER 03774 LAT: 51.08 LONG: -0.21 STN. HT(M): 144 MOD. HT(M):***** N. REPORTS= 10 N. OBS USED IN STATISTICS= 10
STATS FOR ANALYSIS HOUR : 6 MODEL TYPE= TEMP . SONDE CORRECTIONS REMOVED OBS. WITH GROSS ERRORS MAY BE INCLUDED
P(MB) N.OBS/M.FG
DEWPT(K)
WIND SPEED(KTS)
WIND DIRECTION(DEG)
RMS VECTOR WIND(KTS)
KEY: _____ RMS OBS-BACK. _ _ _ RMS OBS-ANAL. STATISTICS PLOTTED IF 5 OR MORE OBS FOR A VARIABLE



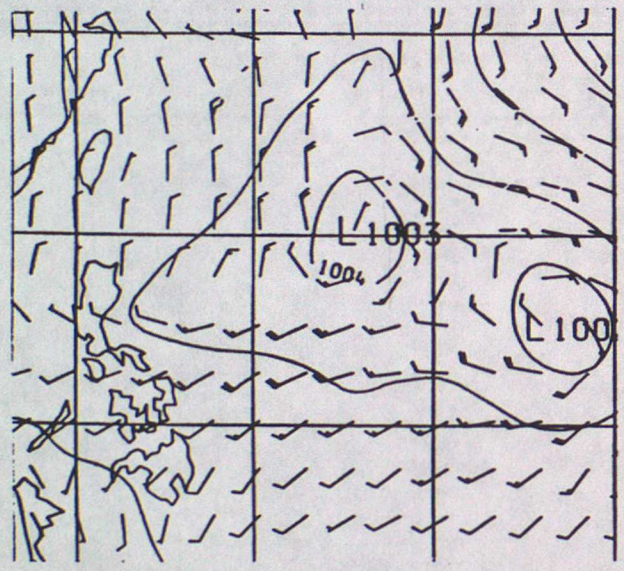
DT = 00UTC 16 September 1991



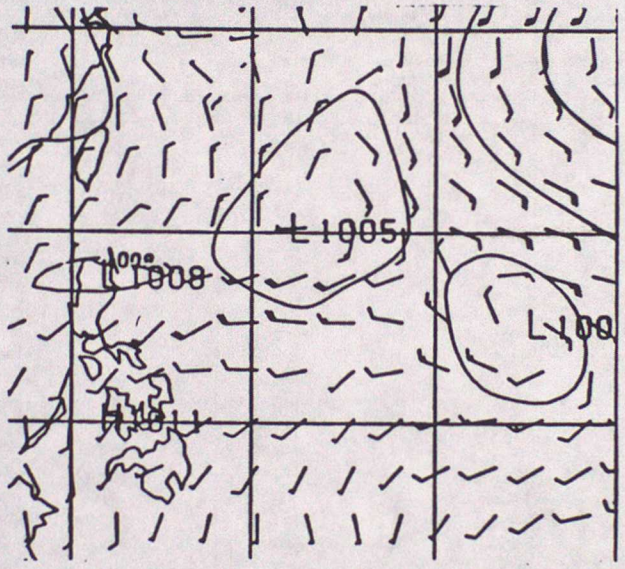
VT = 00UTC 21 September 1991



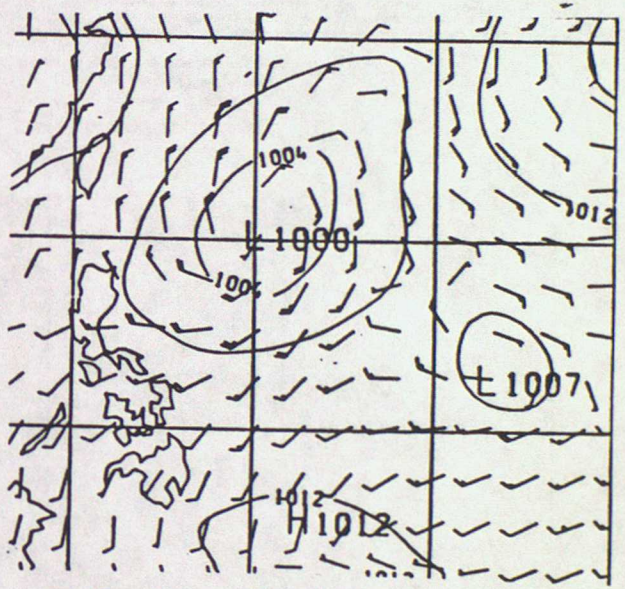
T+120. VT = 00UTC 21 September 1991



T+96. VT = 00UTC 21 September 1991



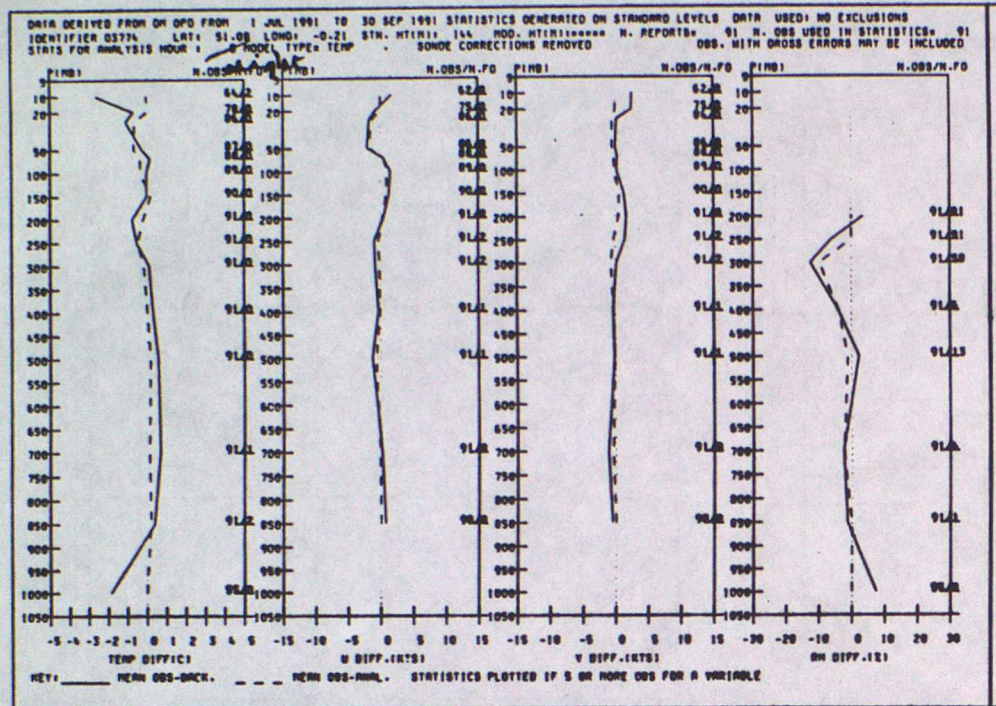
T+72. VT = 00UTC 21 September 1991

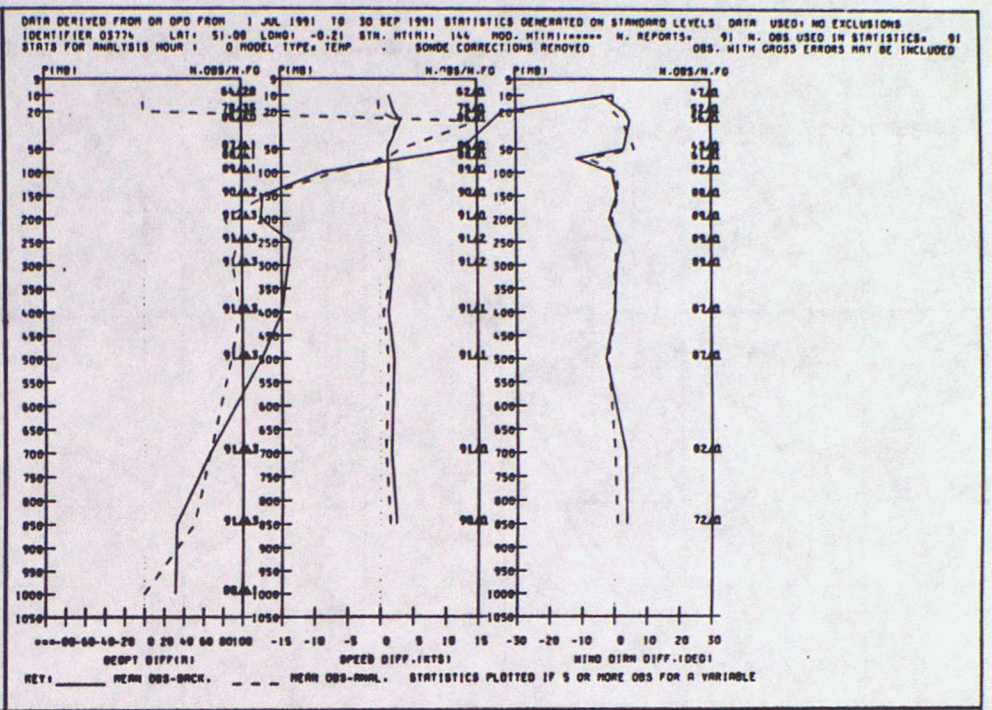


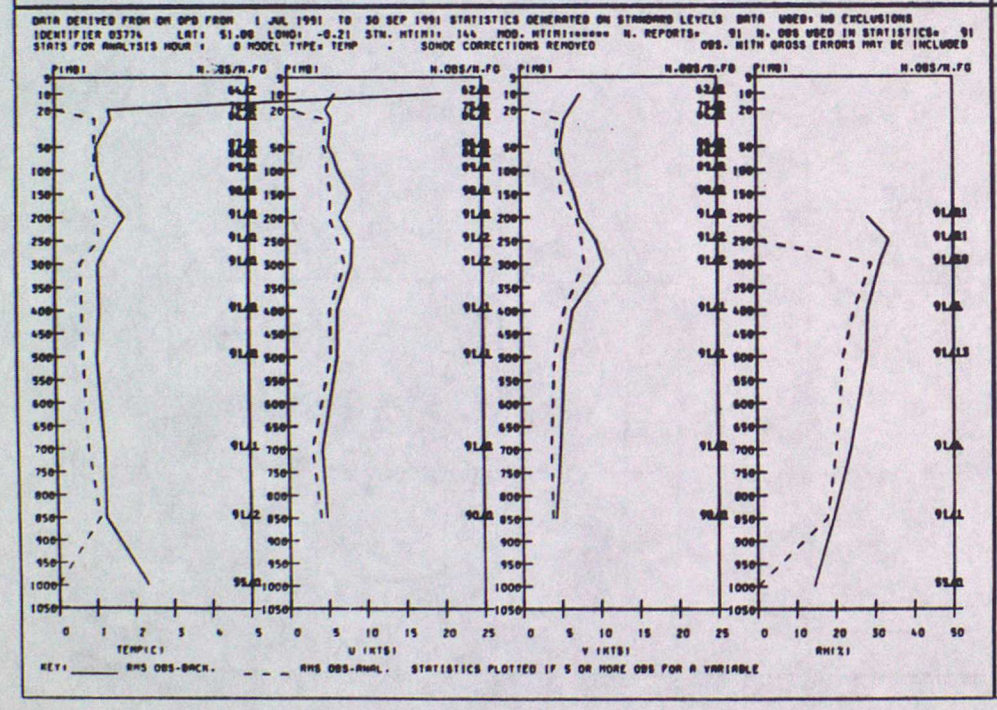
T+48. VT = 00UTC 21 September 1991

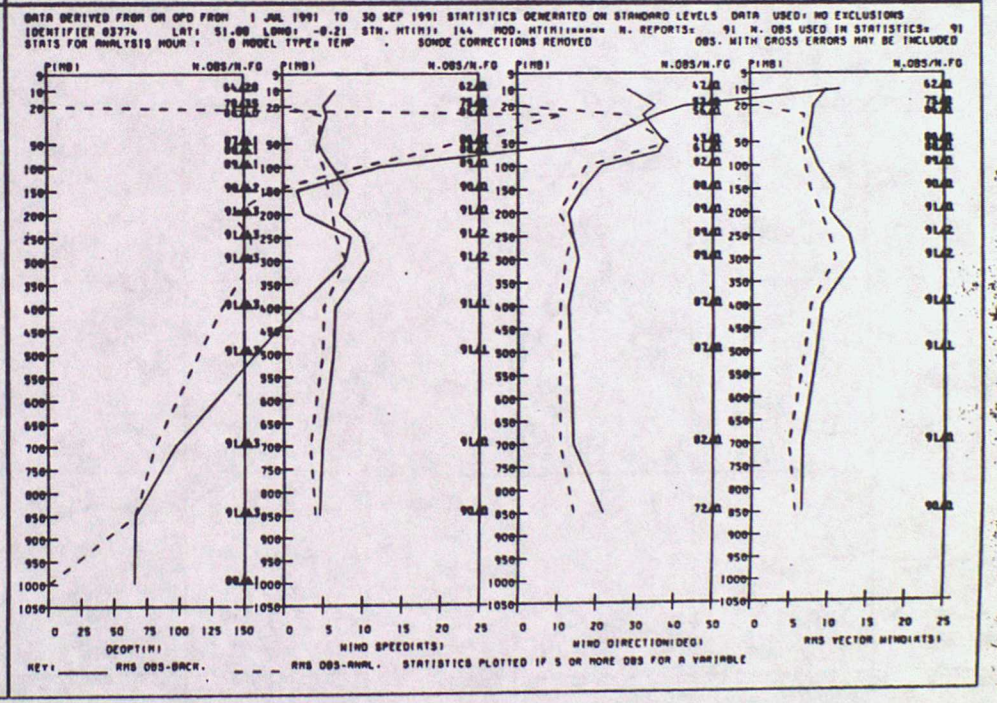
Figure 13. NAT. Verification time VT = 00UTC 21 September 1991. First reported 00UTC 16 September 1991 (VT-120).

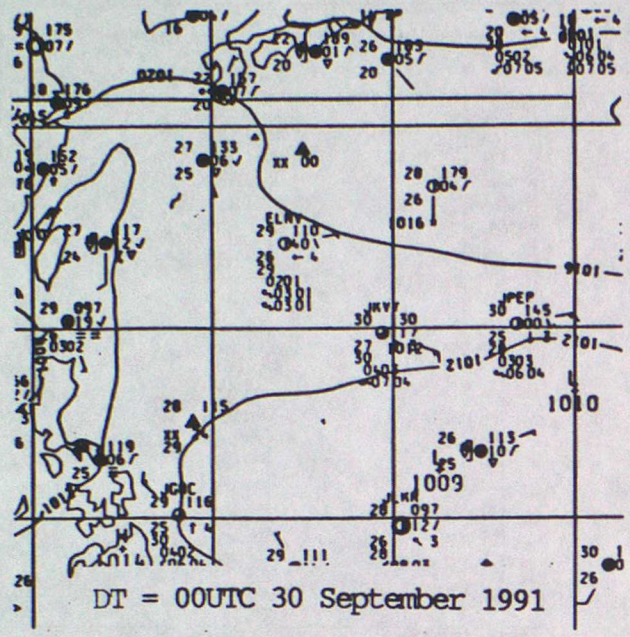
uRC.1


DATA DERIVED FROM OA OPD FROM 1 JUL 1991 TO 30 SEP 1991 STATISTICS GENERATED ON STANDARD LEVELS DATA USED: NO EXCLUSIONS
IDENTIFIER 03774 LAT: 51.08 LONG: -0.21 STN. HT(M): 144 MOD. HT(M): N. REPORTS= 91 N. OBS USED IN STATISTICS= 91
STATS FOR ANALYSIS HOUR : 0 MODEL TYPE= TEMP . SONDE CORRECTIONS REMOVED OBS. WITH GROSS ERRORS MAY BE INCLUDED
P(MB) N.OBS/M.FG
TEMP DIFF(C)
U DIFF.(KTS)
V DIFF.(KTS)
RH DIFF.(%)
KEY: _____ MEAN OBS-BACK. _ _ _ MEAN OBS-ANAL. STATISTICS PLOTTED IF 5 OR MORE OBS FOR A VARIABLE

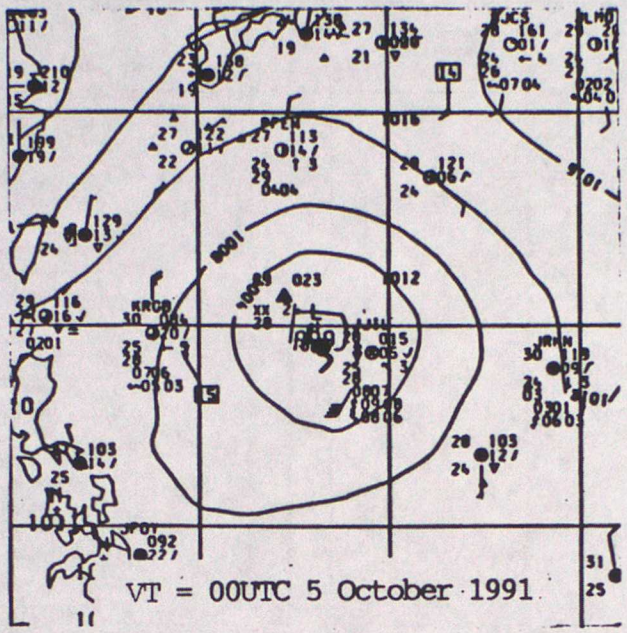

DATA DERIVED FROM OA OPD FROM 1 JUL 1991 TO 30 SEP 1991 STATISTICS GENERATED ON STANDARD LEVELS DATA USED: NO EXCLUSIONS
IDENTIFIER 03774 LAT: 51.08 LONG: -0.21 STN. HT(M): 144 MOD. HT(M): N. REPORTS= 91 N. OBS USED IN STATISTICS= 91
STATS FOR ANALYSIS HOUR : 0 MODEL TYPE= TEMP . SONDE CORRECTIONS REMOVED OBS. WITH GROSS ERRORS MAY BE INCLUDED
P(MB) N.OBS/M.FG
DEPT DIFF(M)
SPEED DIFF.(KTS)
WIND DIRN DIFF.(DEG)
KEY: _____ MEAN OBS-BACK. _ _ _ MEAN OBS-ANAL. STATISTICS PLOTTED IF 5 OR MORE OBS FOR A VARIABLE


DATA DERIVED FROM OA OPD FROM 1 JUL 1991 TO 30 SEP 1991 STATISTICS GENERATED ON STANDARD LEVELS DATA USED: NO EXCLUSIONS
IDENTIFIER 03774 LAT: 51.08 LONG: -0.21 STN. HT(M): 144 MOD. HT(M): N. REPORTS= 91 N. OBS USED IN STATISTICS= 91
STATS FOR ANALYSIS HOUR : 0 MODEL TYPE= TEMP . SONDE CORRECTIONS REMOVED OBS. WITH GROSS ERRORS MAY BE INCLUDED
P(MB) N.OBS/M.FG
TEMP(C)
U (KTS)
V (KTS)
RH(%)
KEY: _____ RMS OBS-BACK. _ _ _ RMS OBS-ANAL. STATISTICS PLOTTED IF 5 OR MORE OBS FOR A VARIABLE

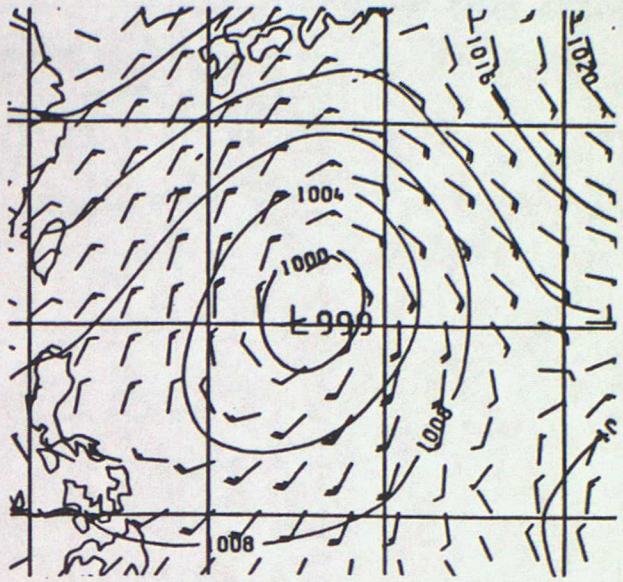

DATA DERIVED FROM OA OPD FROM 1 JUL 1991 TO 30 SEP 1991 STATISTICS GENERATED ON STANDARD LEVELS DATA USED: NO EXCLUSIONS
IDENTIFIER 03774 LAT: 51.08 LONG: -0.21 STN. HT(M): 144 MOD. HT(M): N. REPORTS= 91 N. OBS USED IN STATISTICS= 91
STATS FOR ANALYSIS HOUR : 0 MODEL TYPE= TEMP . SONDE CORRECTIONS REMOVED OBS. WITH GROSS ERRORS MAY BE INCLUDED
P(MB) N.OBS/M.FG
DEPTH(M)
WIND SPEED(KTS)
WIND DIRECTION(DEG)
RMS VECTOR WIND(KTS)
KEY: _____ RMS OBS-BACK. _ _ _ RMS OBS-ANAL. STATISTICS PLOTTED IF 5 OR MORE OBS FOR A VARIABLE



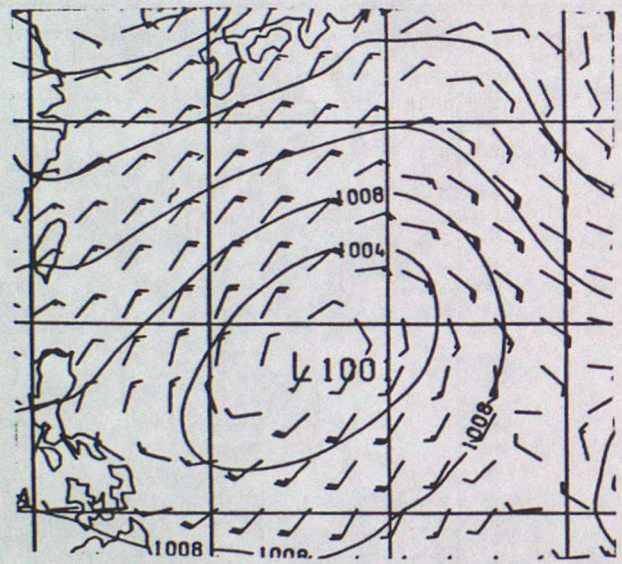
DT = 00UTC 30 September 1991



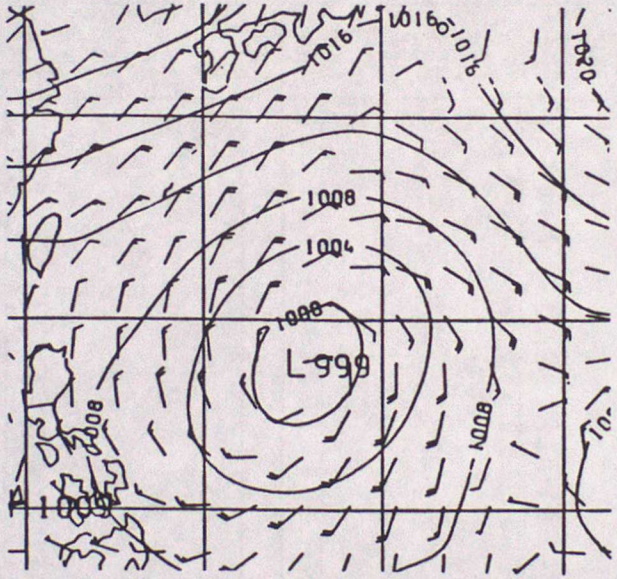
VT = 00UTC 5 October 1991



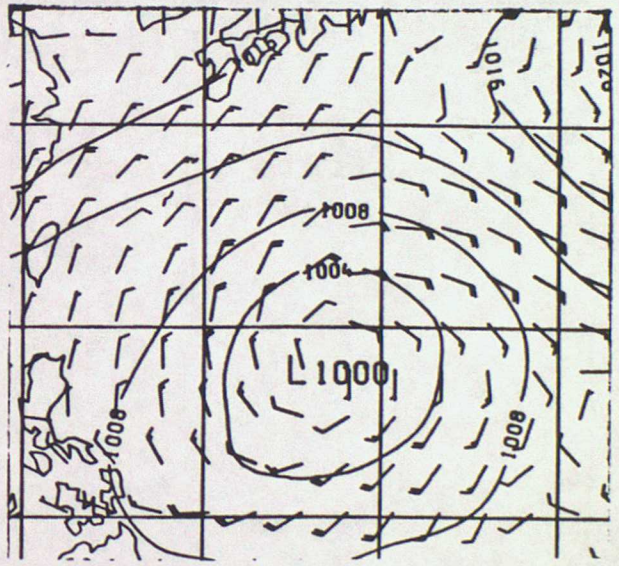
T+120. VT = 00UTC 5 October 1991



T+96. VT = 00UTC 5 October 1991



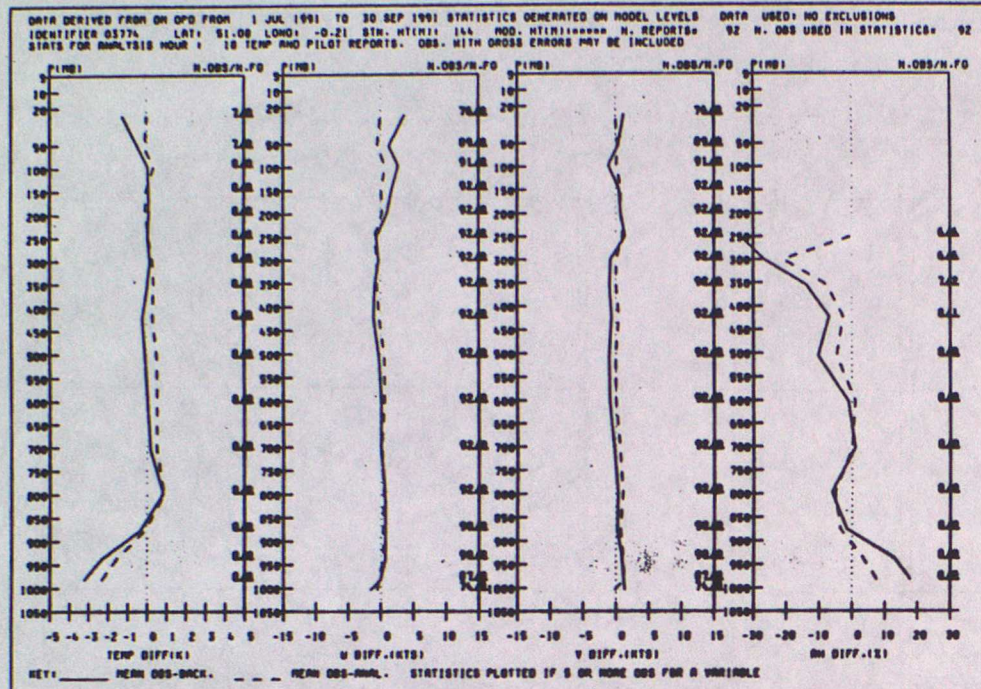
T+72. VT = 00UTC 5 October 1991

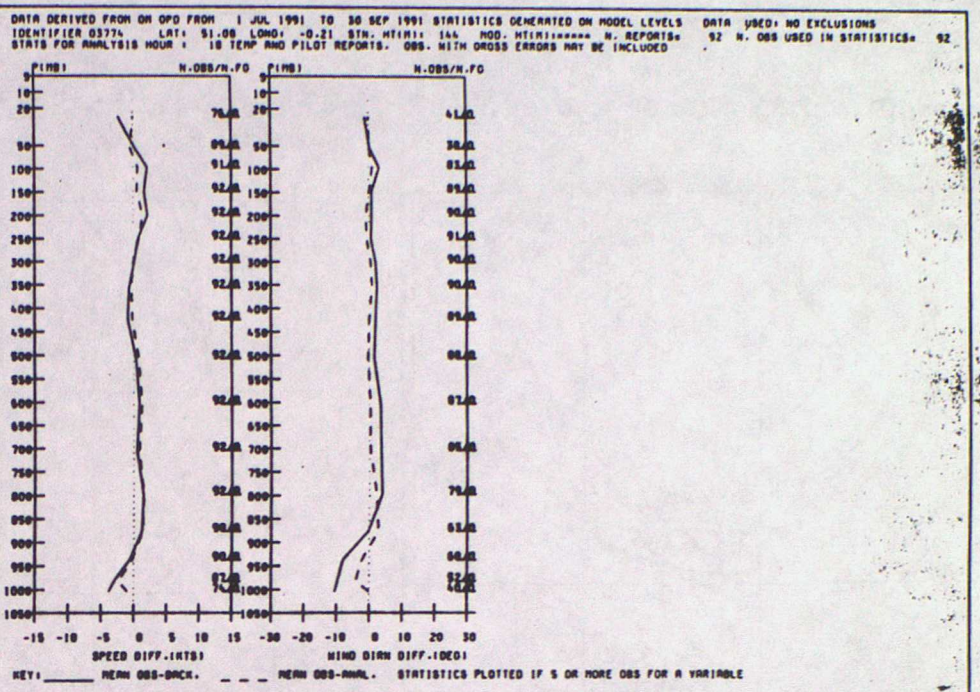


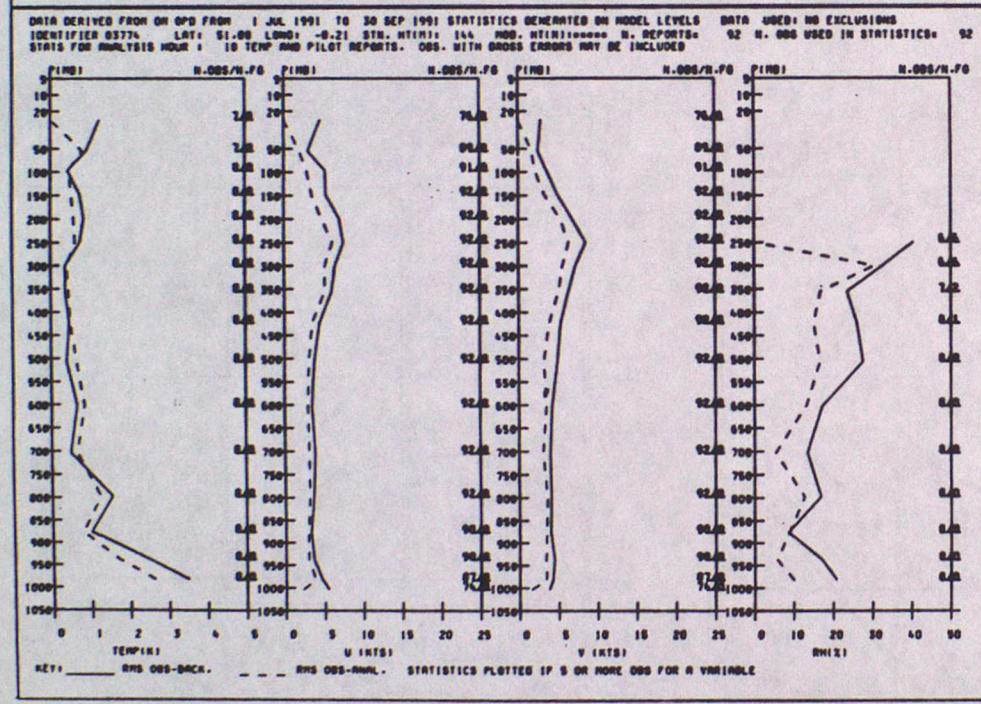
T+48. VT = 00UTC 5 October 1991

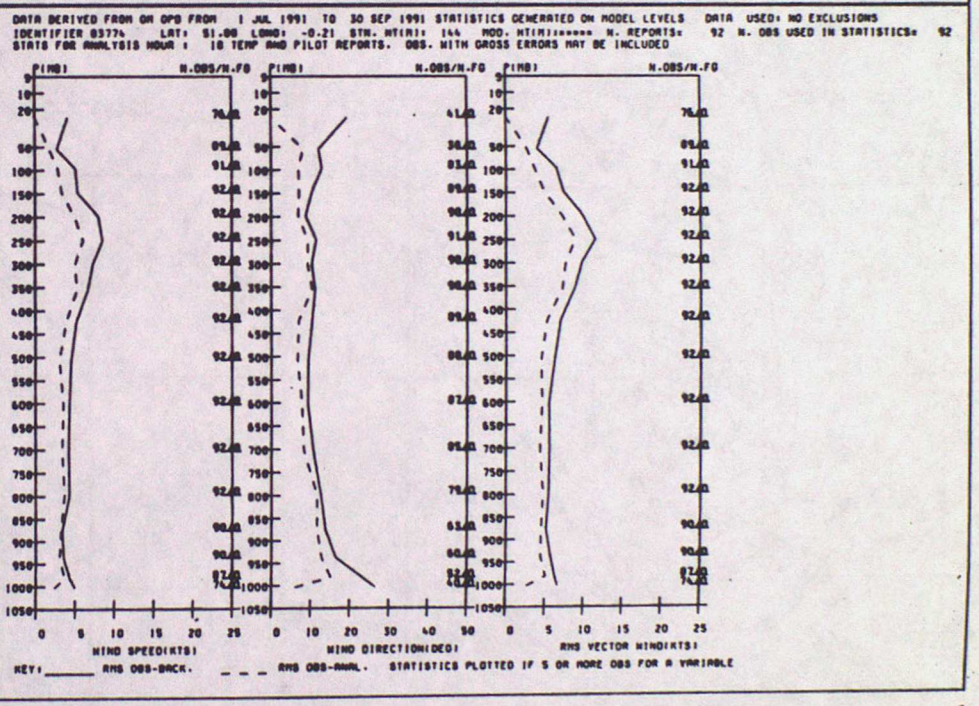
Figure 14. ORCHID. Verification time VT = 00UTC 5 October 1991. First reported 00UTC 4 October 1991 (VT-24).

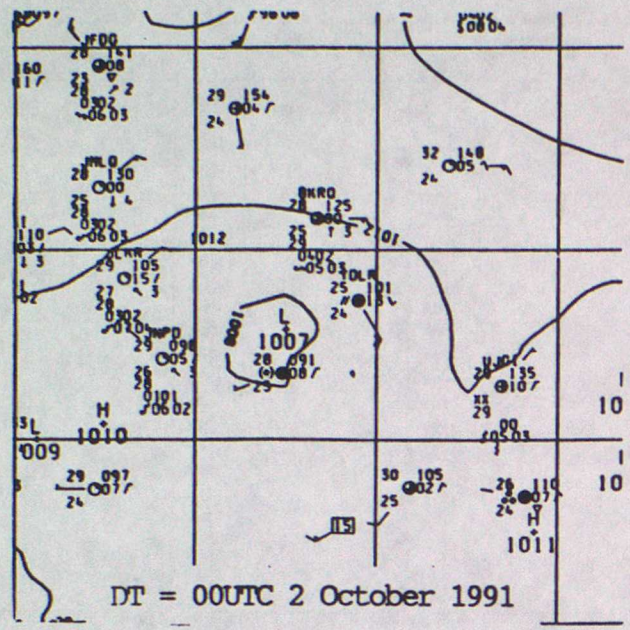
CAB.4

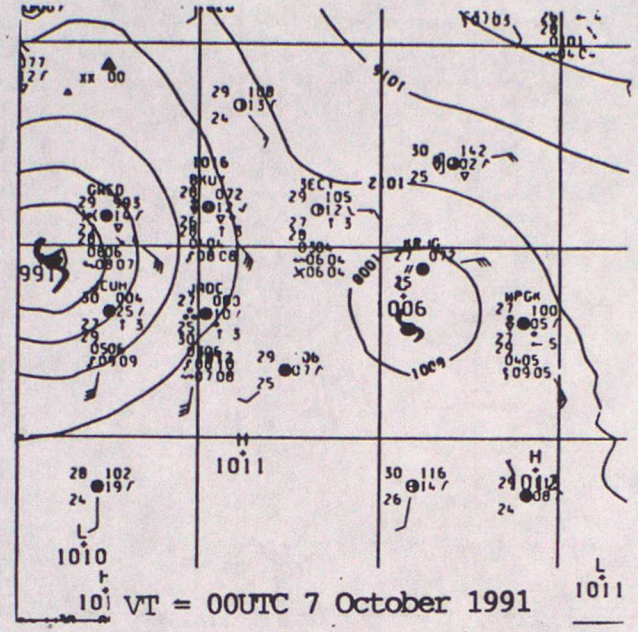

DATA DERIVED FROM OPS FROM 1 JUL 1991 TO 30 SEP 1991 STATISTICS GENERATED ON MODEL LEVELS DATA USED: NO EXCLUSIONS
IDENTIFIER 03774 LAT: 51.00 LONG: -0.21 STN. HT(M): 144 MOD. HT(M): N. REPORTS= 92 N. OBS USED IN STATISTICS= 92
STATS FOR ANALYSIS HOUR : 18 TEMP AND PILOT REPORTS. OBS. WITH GROSS ERRORS MAY BE INCLUDED
P(MB) N.OBS/N.FG
TEMP DIFF(K)
U DIFF.(KTS)
V DIFF.(KTS)
RH DIFF.(%)
KEY: _____ MEAN OBS-BACK. _ _ _ MEAN OBS-ANAL. STATISTICS PLOTTED IF 5 OR MORE OBS FOR A VARIABLE

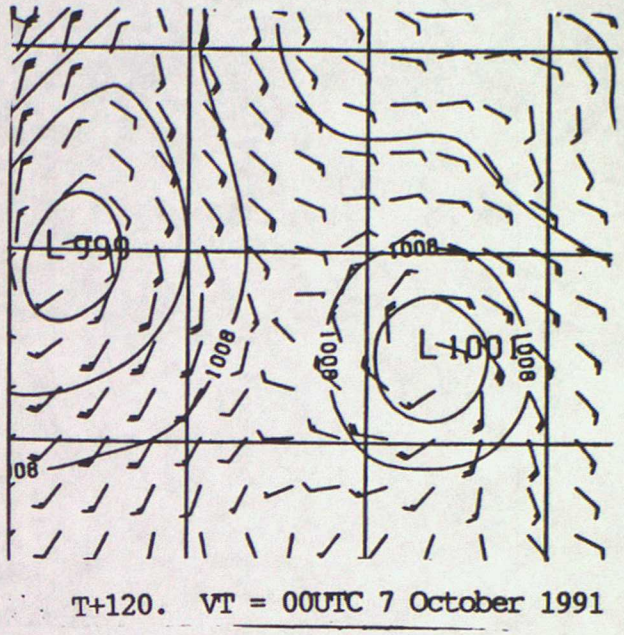

DATA DERIVED FROM OPS FROM 1 JUL 1991 TO 30 SEP 1991 STATISTICS GENERATED ON MODEL LEVELS DATA USED: NO EXCLUSIONS
IDENTIFIER 03774 LAT: 51.00 LONG: -0.21 STN. HT(M): 144 MOD. HT(M): N. REPORTS= 92 N. OBS USED IN STATISTICS= 92
STATS FOR ANALYSIS HOUR : 18 TEMP AND PILOT REPORTS. OBS. WITH GROSS ERRORS MAY BE INCLUDED
P(MB) N.OBS/N.FG
SPEED DIFF.(KTS)
WIND DIRN DIFF.(DEG)
KEY: _____ MEAN OBS-BACK. _ _ _ MEAN OBS-ANAL. STATISTICS PLOTTED IF 5 OR MORE OBS FOR A VARIABLE

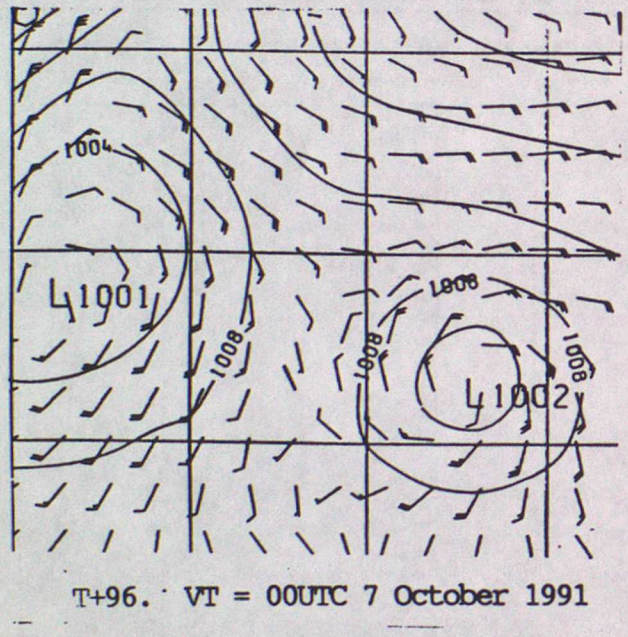

DATA DERIVED FROM OPS FROM 1 JUL 1991 TO 30 SEP 1991 STATISTICS GENERATED ON MODEL LEVELS DATA USED: NO EXCLUSIONS
IDENTIFIER 03774 LAT: 51.00 LONG: -0.21 STN. HT(M): 144 MOD. HT(M): N. REPORTS= 92 N. OBS USED IN STATISTICS= 92
STATS FOR ANALYSIS HOUR : 18 TEMP AND PILOT REPORTS. OBS. WITH GROSS ERRORS MAY BE INCLUDED
P(MB) N.OBS/N.FG
TEMP(K)
U (KTS)
V (KTS)
RH(%)
KEY: _____ RMS OBS-BACK. _ _ _ RMS OBS-ANAL. STATISTICS PLOTTED IF 5 OR MORE OBS FOR A VARIABLE

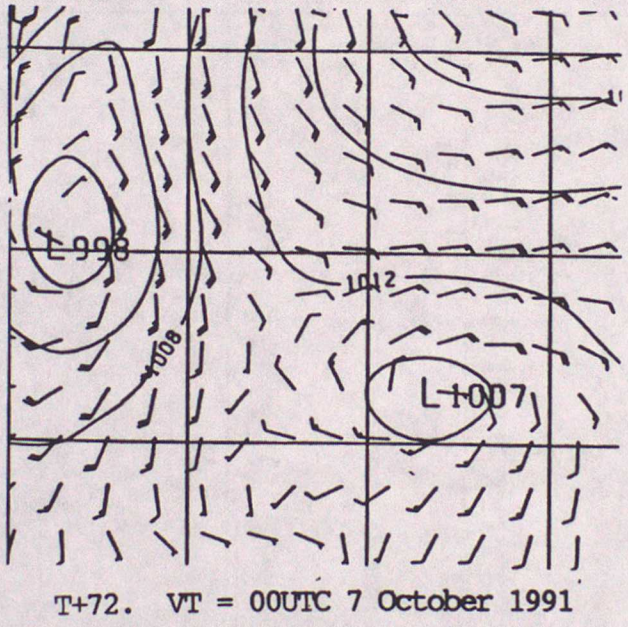

DATA DERIVED FROM OPS FROM 1 JUL 1991 TO 30 SEP 1991 STATISTICS GENERATED ON MODEL LEVELS DATA USED: NO EXCLUSIONS
IDENTIFIER 03774 LAT: 51.00 LONG: -0.21 STN. HT(M): 144 MOD. HT(M): N. REPORTS= 92 N. OBS USED IN STATISTICS= 92
STATS FOR ANALYSIS HOUR : 18 TEMP AND PILOT REPORTS. OBS. WITH GROSS ERRORS MAY BE INCLUDED
P(MB) N.OBS/N.FG
WIND SPEED(KTS)
WIND DIRECTION(DEG)
RMS VECTOR WIND(KTS)
KEY: _____ RMS OBS-BACK. _ _ _ RMS OBS-ANAL. STATISTICS PLOTTED IF 5 OR MORE OBS FOR A VARIABLE











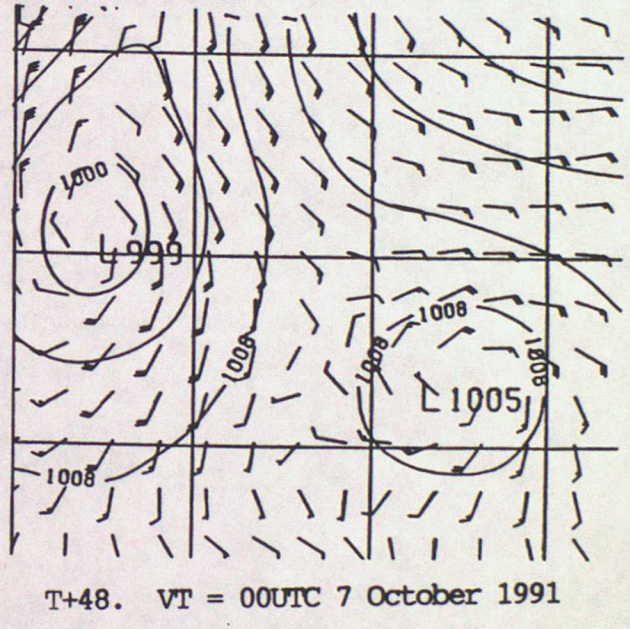
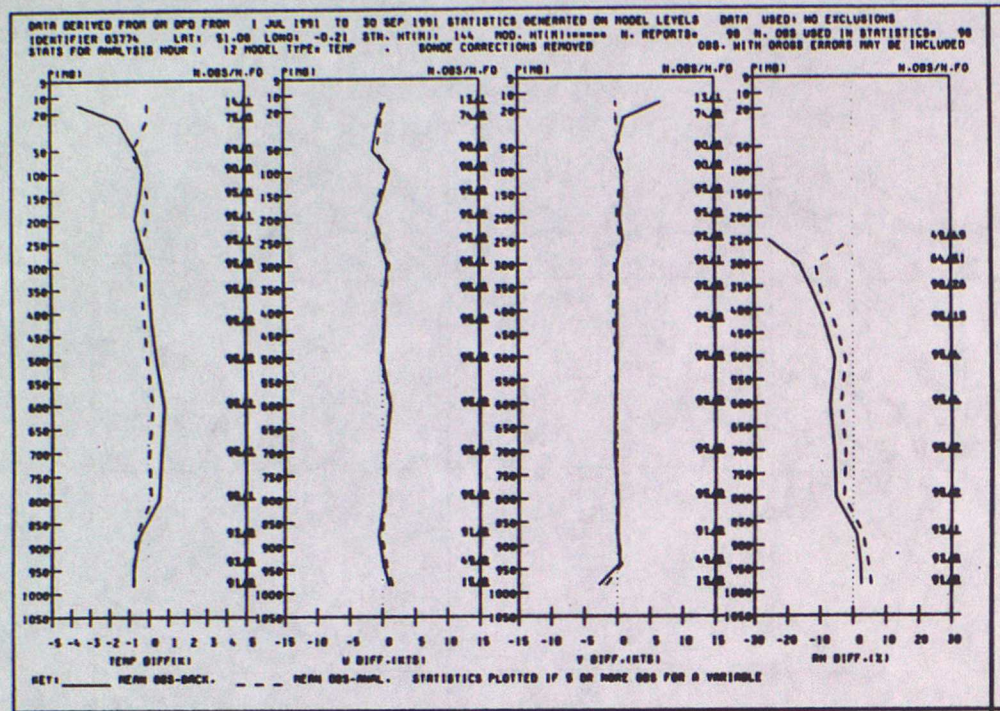
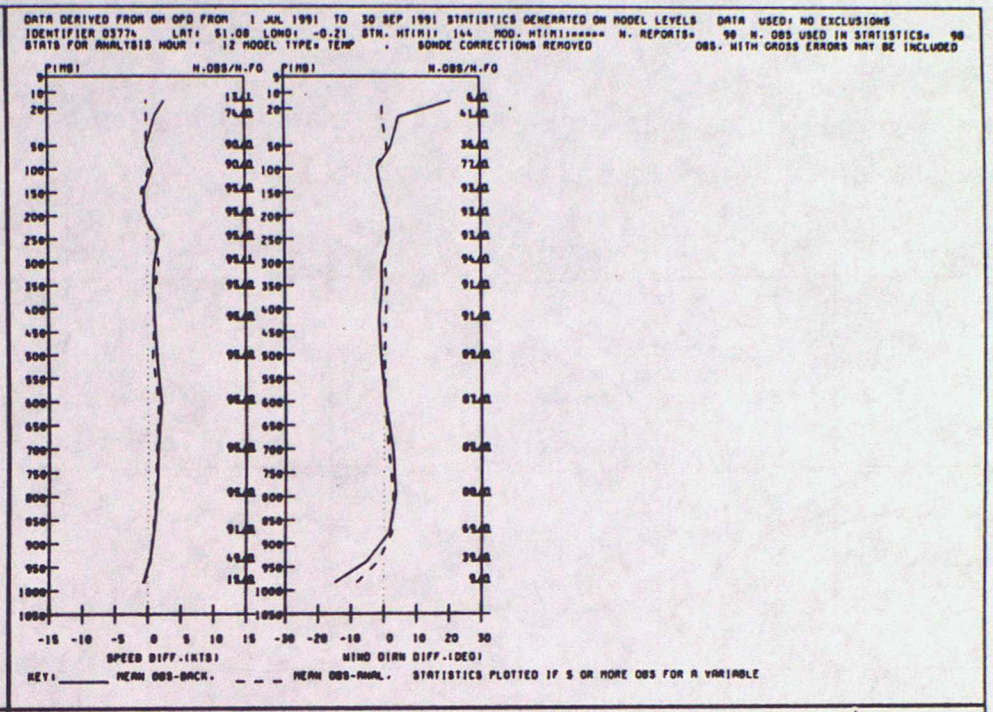
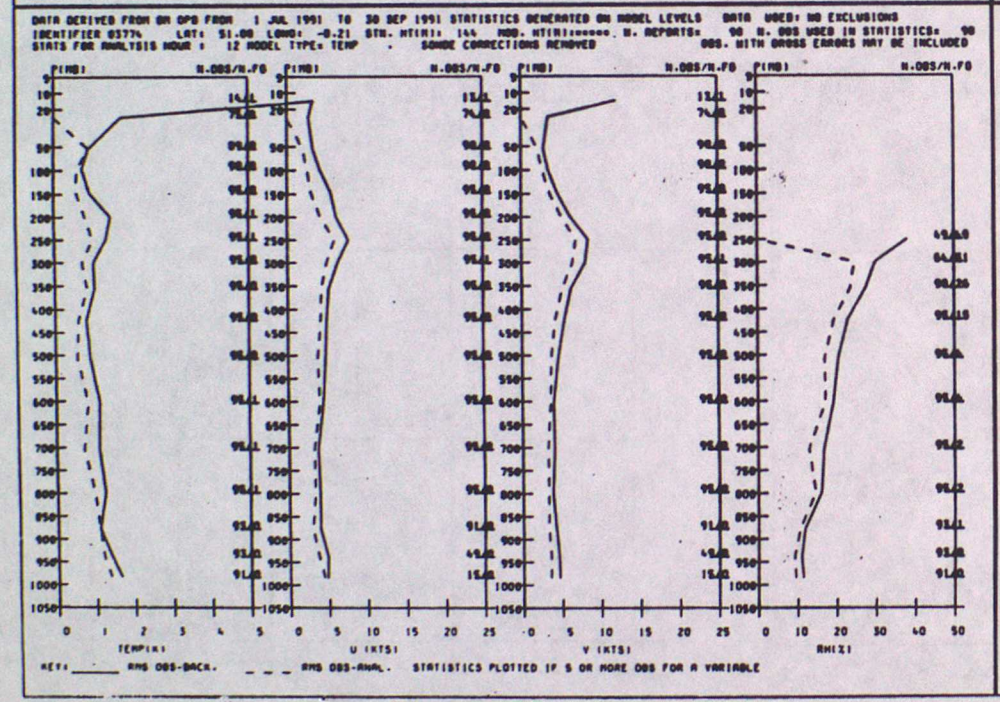


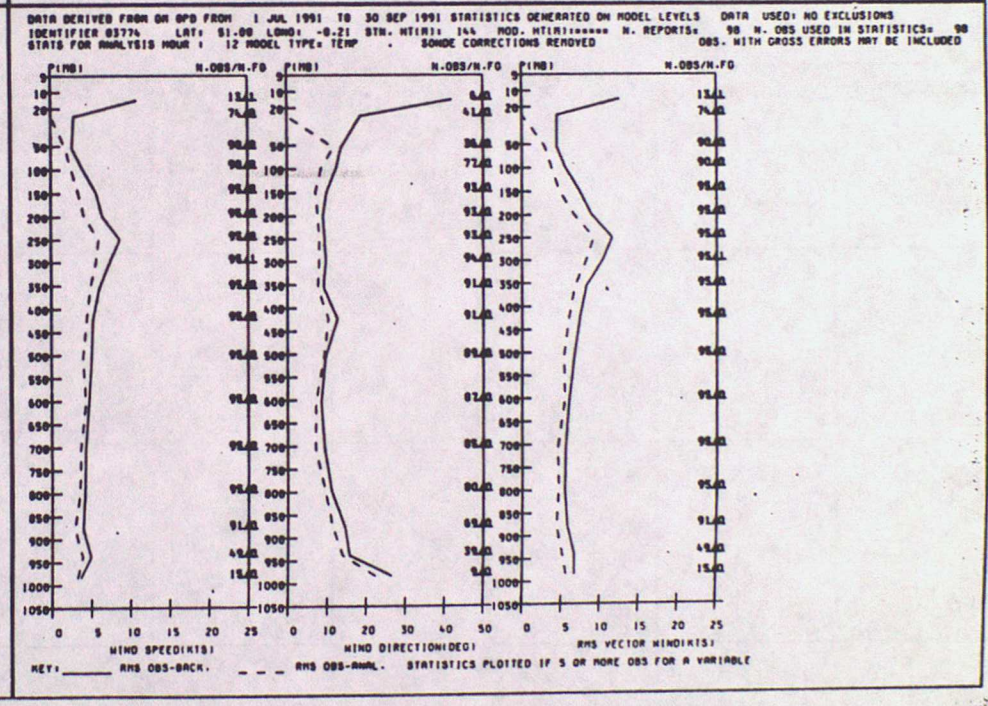
Figure 15. PAT. Verification time VT = 00UTC 7 October 1991. First reported 12UTC 5 October 1991 (VT-36).

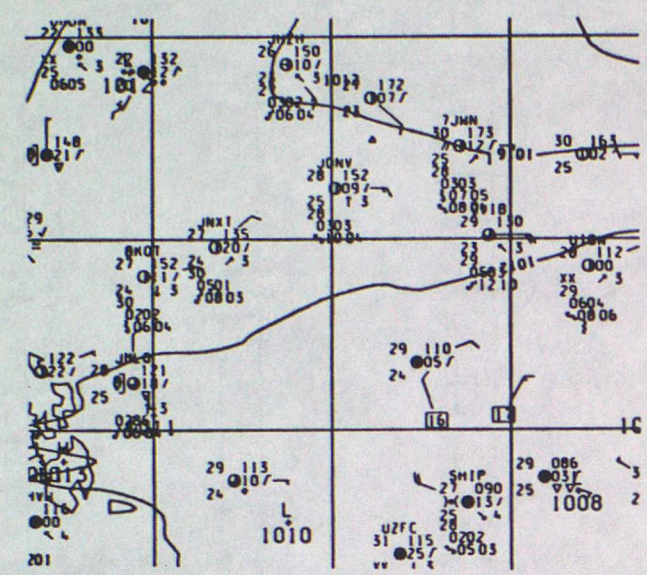
URB-3


DATA DERIVED FROM GM GPD FROM 1 JUL 1991 TO 30 SEP 1991 STATISTICS GENERATED ON MODEL LEVELS DATA USED: NO EXCLUSIONS
IDENTIFIER 03774 LAT: 51.08 LONG: -0.21 STN. HT(M): 144 MOD. HT(M):***** N. REPORTS= 98 N. OBS USED IN STATISTICS= 98
STATS FOR ANALYSIS HOUR : 12 MODEL TYPE= TEMP . SONDE CORRECTIONS REMOVED OBS. WITH GROSS ERRORS MAY BE INCLUDED
P(MB) N.OBS/M.FG
TEMP DIFF(K)
U DIFF.(KTS)
V DIFF.(KTS)
RH DIFF.(%)
KEY: _____ MEAN OBS-BACK. _ _ _ MEAN OBS-ANAL. STATISTICS PLOTTED IF 5 OR MORE OBS FOR A VARIABLE

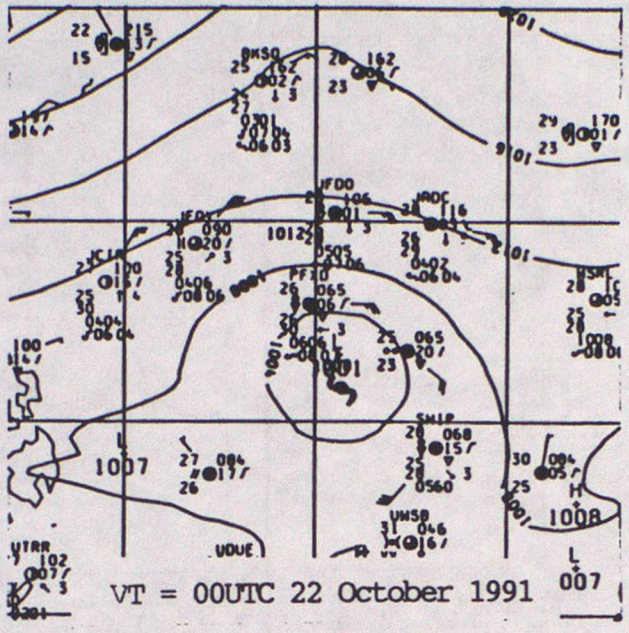

DATA DERIVED FROM GM GPD FROM 1 JUL 1991 TO 30 SEP 1991 STATISTICS GENERATED ON MODEL LEVELS DATA USED: NO EXCLUSIONS
IDENTIFIER 03774 LAT: 51.08 LONG: -0.21 STN. HT(M): 144 MOD. HT(M):***** N. REPORTS= 98 N. OBS USED IN STATISTICS= 98
STATS FOR ANALYSIS HOUR : 12 MODEL TYPE= TEMP . SONDE CORRECTIONS REMOVED OBS. WITH GROSS ERRORS MAY BE INCLUDED
P(MB) N.OBS/M.FG
SPEED DIFF.(KTS)
WIND DIRN DIFF.(DEG)
KEY: _____ MEAN OBS-BACK. _ _ _ MEAN OBS-ANAL. STATISTICS PLOTTED IF 5 OR MORE OBS FOR A VARIABLE


DATA DERIVED FROM GM GPD FROM 1 JUL 1991 TO 30 SEP 1991 STATISTICS GENERATED ON MODEL LEVELS DATA USED: NO EXCLUSIONS
IDENTIFIER 03774 LAT: 51.08 LONG: -0.21 STN. HT(M): 144 MOD. HT(M):***** N. REPORTS= 98 N. OBS USED IN STATISTICS= 98
STATS FOR ANALYSIS HOUR : 12 MODEL TYPE= TEMP . SONDE CORRECTIONS REMOVED OBS. WITH GROSS ERRORS MAY BE INCLUDED
P(MB) N.OBS/M.FG
TEMP(K)
U (KTS)
V (KTS)
RH(%)
KEY: _____ RMS OBS-BACK. _ _ _ RMS OBS-ANAL. STATISTICS PLOTTED IF 5 OR MORE OBS FOR A VARIABLE

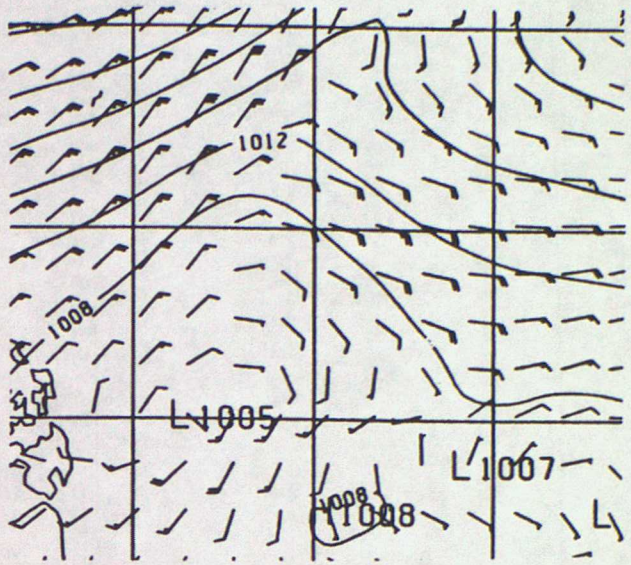

DATA DERIVED FROM GM GPD FROM 1 JUL 1991 TO 30 SEP 1991 STATISTICS GENERATED ON MODEL LEVELS DATA USED: NO EXCLUSIONS
IDENTIFIER 03774 LAT: 51.08 LONG: -0.21 STN. HT(M): 144 MOD. HT(M):***** N. REPORTS= 98 N. OBS USED IN STATISTICS= 98
STATS FOR ANALYSIS HOUR : 12 MODEL TYPE= TEMP . SONDE CORRECTIONS REMOVED OBS. WITH GROSS ERRORS MAY BE INCLUDED
P(MB) N.OBS/M.FG
WIND SPEED(KTS)
WIND DIRECTION(DEG)
RMS VECTOR WIND(KTS)
KEY: _____ RMS OBS-BACK. _ _ _ RMS OBS-ANAL. STATISTICS PLOTTED IF 5 OR MORE OBS FOR A VARIABLE



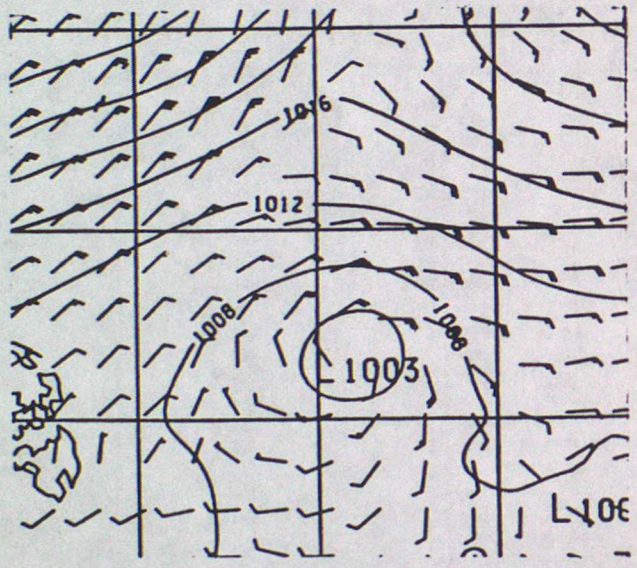
DT = 00UTC 17 October 1991



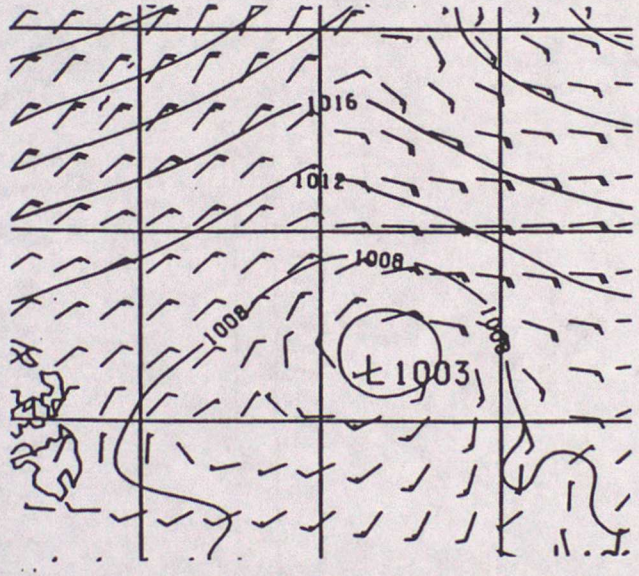
VT = 00UTC 22 October 1991



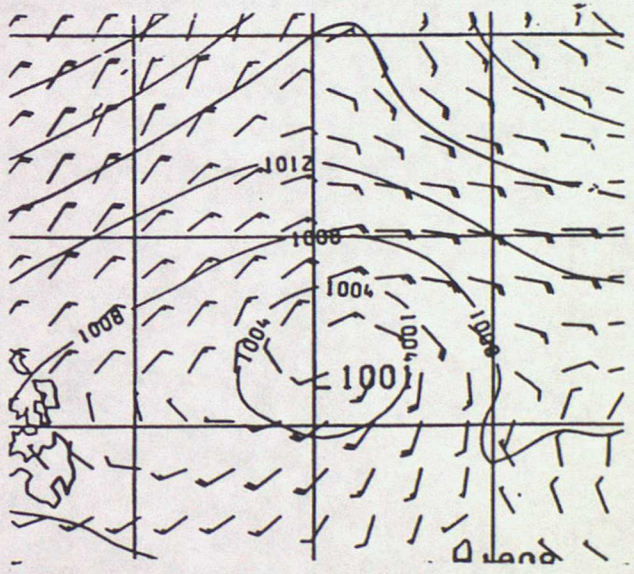
T+120. VT = 00UTC 22 October 1991



T+96. VT = 00UTC 22 October 1991



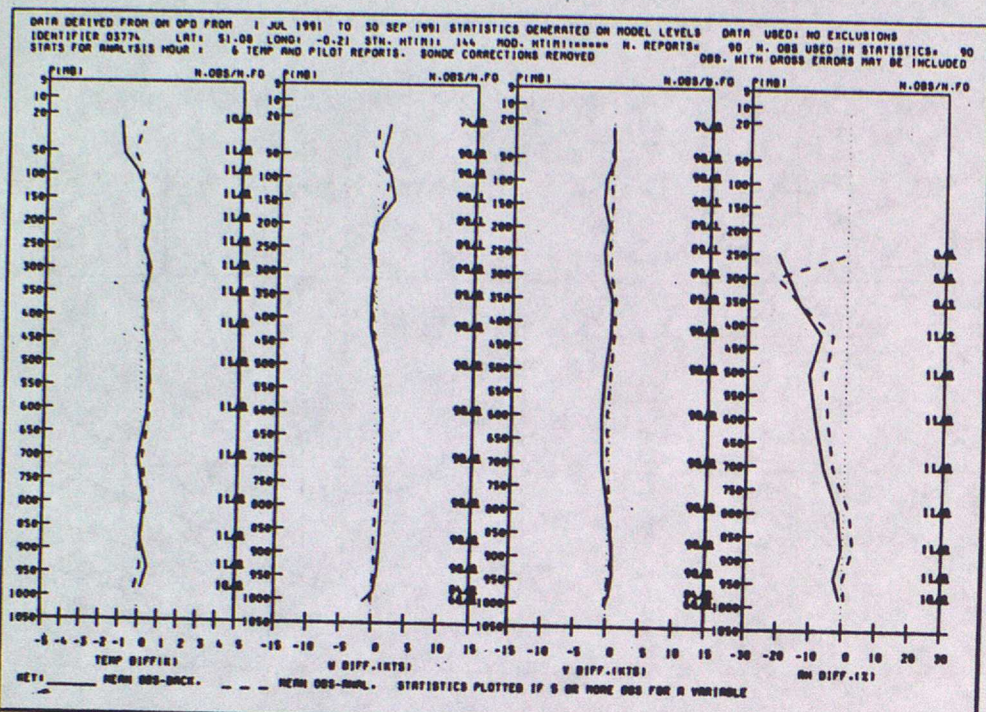
T+72. VT = 00UTC 22 October 1991

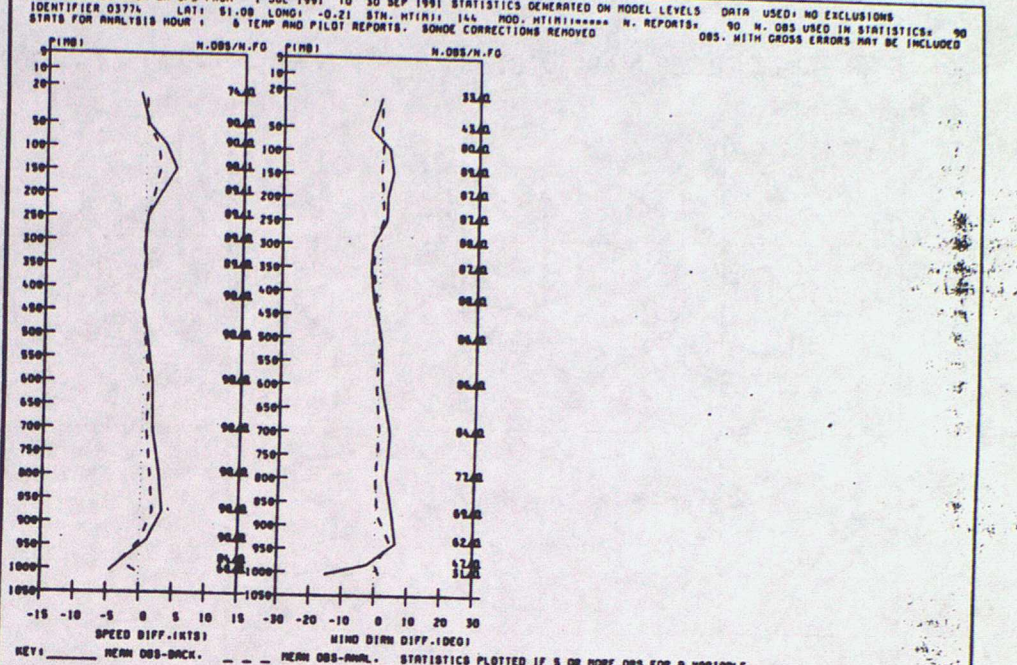


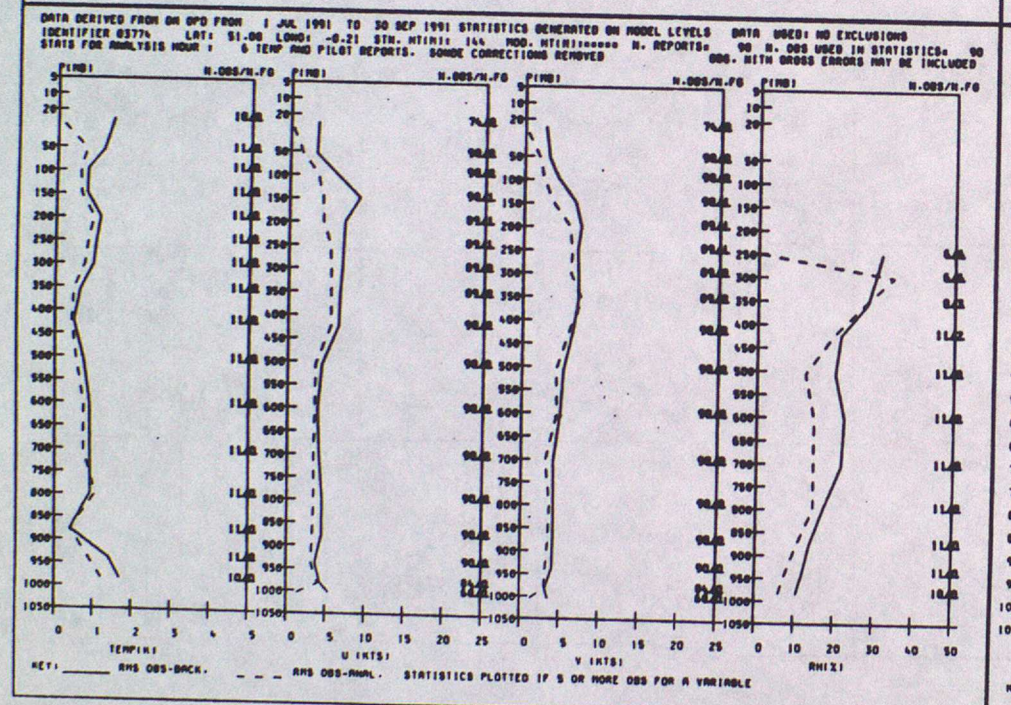
T+48. VT = 00UTC 22 October 1991

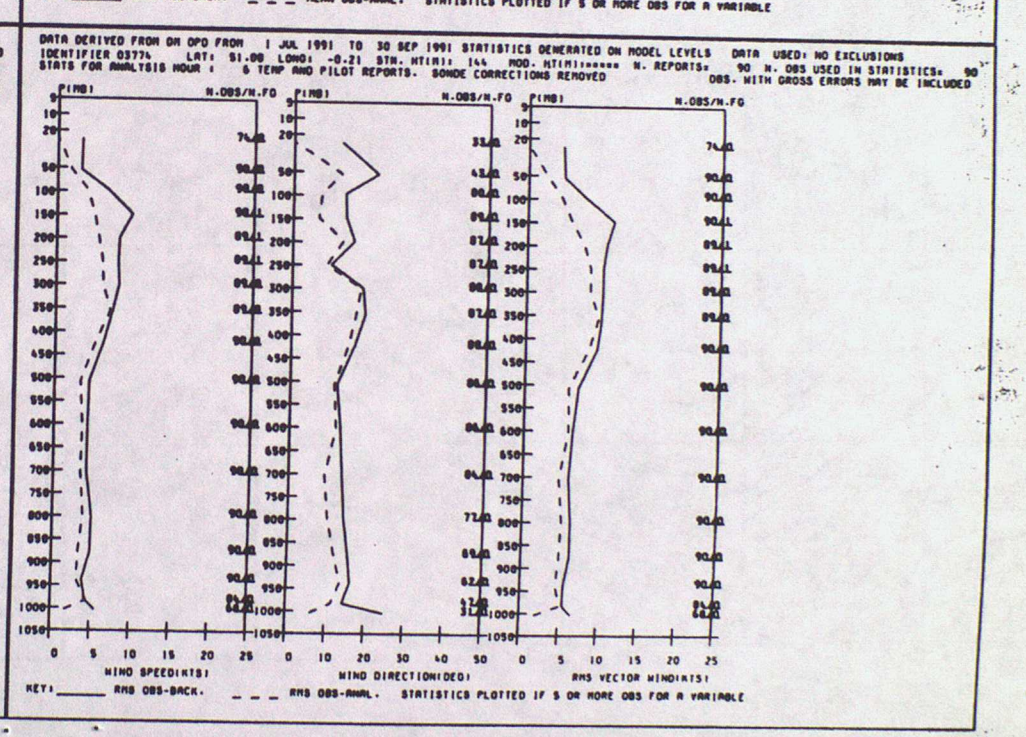
Figure 16. RUTH. Verification time VT = 00UTC 22 October 1991. First reported 18UTC 20 October 1991 (VT-30).

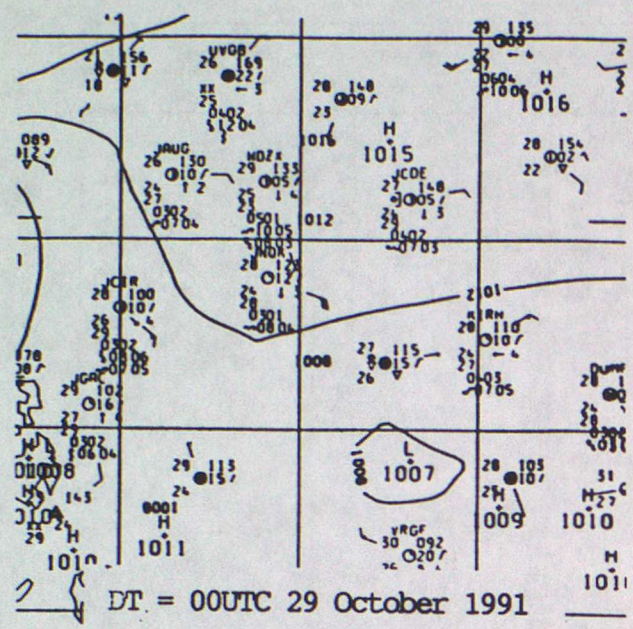
urb.2


DATA DERIVED FROM AN OPD FROM 1 JUL 1991 TO 30 SEP 1991 STATISTICS GENERATED ON MODEL LEVELS DATA USED: NO EXCLUSIONS
IDENTIFIER 03774 LAT: 51.08 LONG: -0.21 STN. HT(M): 144 MOD. HT(M): N. REPORTS= 90 N. OBS USED IN STATISTICS= 90
STATS FOR ANALYSIS HOUR : 6 TEMP AND PILOT REPORTS. SONDE CORRECTIONS REMOVED OBS. WITH GROSS ERRORS MAY BE INCLUDED
P(MB) N.OBS/N.FG
TEMP DIFF(K)
U DIFF.(KTS)
V DIFF.(KTS)
RH DIFF.(%)
KEY: _____ MEAN OBS-BACK. _ _ _ MEAN OBS-ANAL. STATISTICS PLOTTED IF 5 OR MORE OBS FOR A VARIABLE

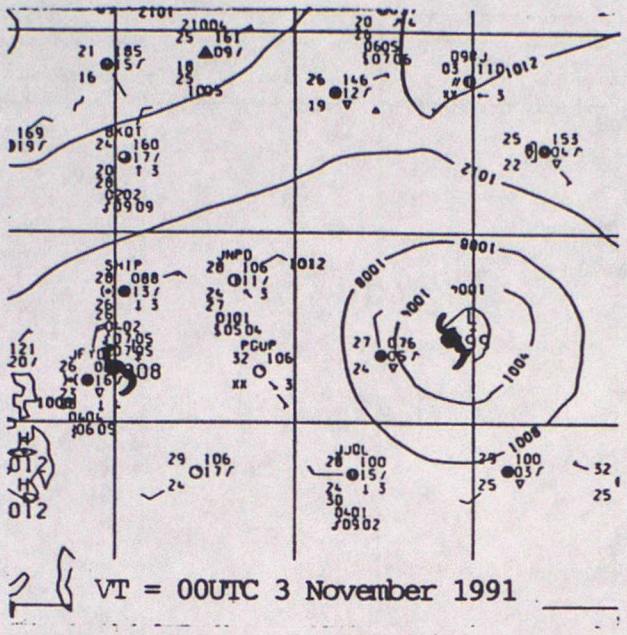

DATA DERIVED FROM AN OPD FROM 1 JUL 1991 TO 30 SEP 1991 STATISTICS GENERATED ON MODEL LEVELS DATA USED: NO EXCLUSIONS
IDENTIFIER 03774 LAT: 51.08 LONG: -0.21 STN. HT(M): 144 MOD. HT(M): N. REPORTS= 90 N. OBS USED IN STATISTICS= 90
STATS FOR ANALYSIS HOUR : 6 TEMP AND PILOT REPORTS. SONDE CORRECTIONS REMOVED OBS. WITH GROSS ERRORS MAY BE INCLUDED
P(MB) N.OBS/N.FG
SPEED DIFF.(KTS)
WIND DIRN DIFF.(DEG)
KEY: _____ MEAN OBS-BACK. _ _ _ MEAN OBS-ANAL. STATISTICS PLOTTED IF 5 OR MORE OBS FOR A VARIABLE


DATA DERIVED FROM AN OPD FROM 1 JUL 1991 TO 30 SEP 1991 STATISTICS GENERATED ON MODEL LEVELS DATA USED: NO EXCLUSIONS
IDENTIFIER 03774 LAT: 51.08 LONG: -0.21 STN. HT(M): 144 MOD. HT(M): N. REPORTS= 90 N. OBS USED IN STATISTICS= 90
STATS FOR ANALYSIS HOUR : 6 TEMP AND PILOT REPORTS. SONDE CORRECTIONS REMOVED OBS. WITH GROSS ERRORS MAY BE INCLUDED
P(MB) N.OBS/N.FG
TEMP(K)
U (KTS)
V (KTS)
RH(%)
KEY: _____ RMS OBS-BACK. _ _ _ RMS OBS-ANAL. STATISTICS PLOTTED IF 5 OR MORE OBS FOR A VARIABLE

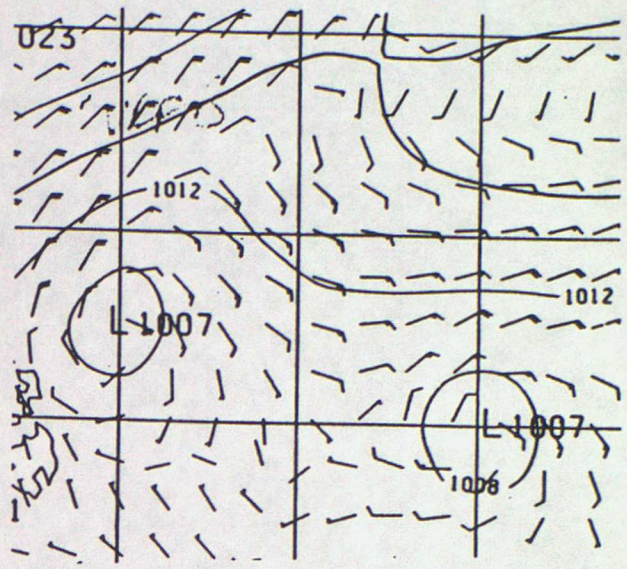

DATA DERIVED FROM AN OPD FROM 1 JUL 1991 TO 30 SEP 1991 STATISTICS GENERATED ON MODEL LEVELS DATA USED: NO EXCLUSIONS
IDENTIFIER 03774 LAT: 51.08 LONG: -0.21 STN. HT(M): 144 MOD. HT(M): N. REPORTS= 90 N. OBS USED IN STATISTICS= 90
STATS FOR ANALYSIS HOUR : 6 TEMP AND PILOT REPORTS. SONDE CORRECTIONS REMOVED OBS. WITH GROSS ERRORS MAY BE INCLUDED
P(MB) N.OBS/N.FG
WIND SPEED(KTS)
WIND DIRECTION(DEG)
RMS VECTOR WIND(KTS)
KEY: _____ RMS OBS-BACK. _ _ _ RMS OBS-ANAL. STATISTICS PLOTTED IF 5 OR MORE OBS FOR A VARIABLE



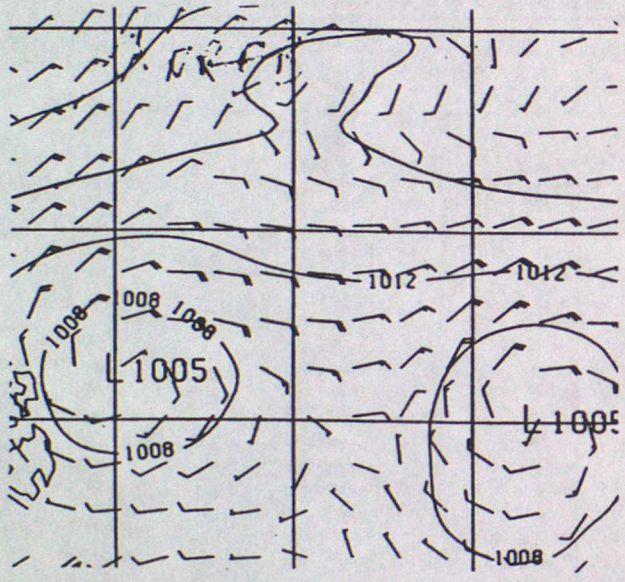
DT = 00UTC 29 October 1991



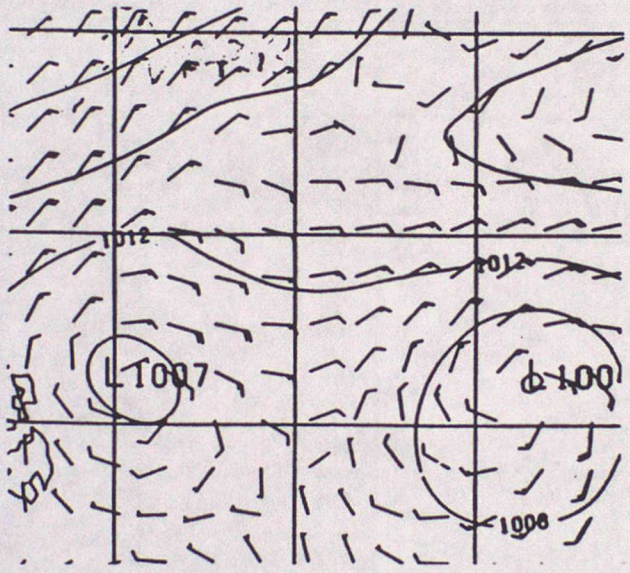
VT = 00UTC 3 November 1991



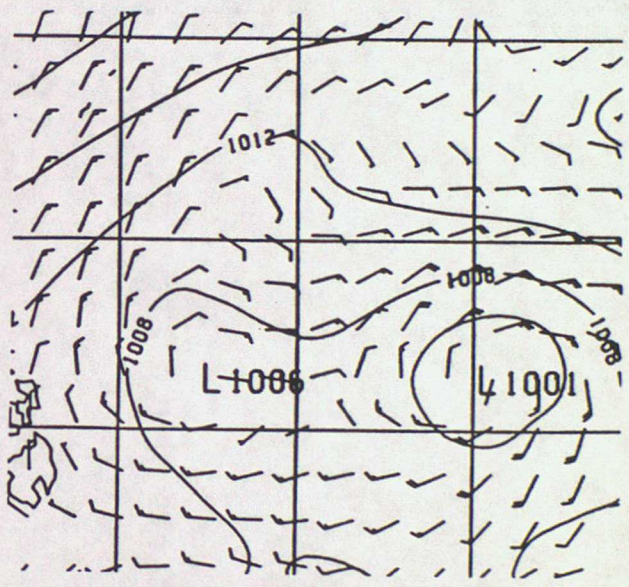
T+120. VT = 00UTC 3 November 1991



T+96. VT = 00UTC 3 November 1991



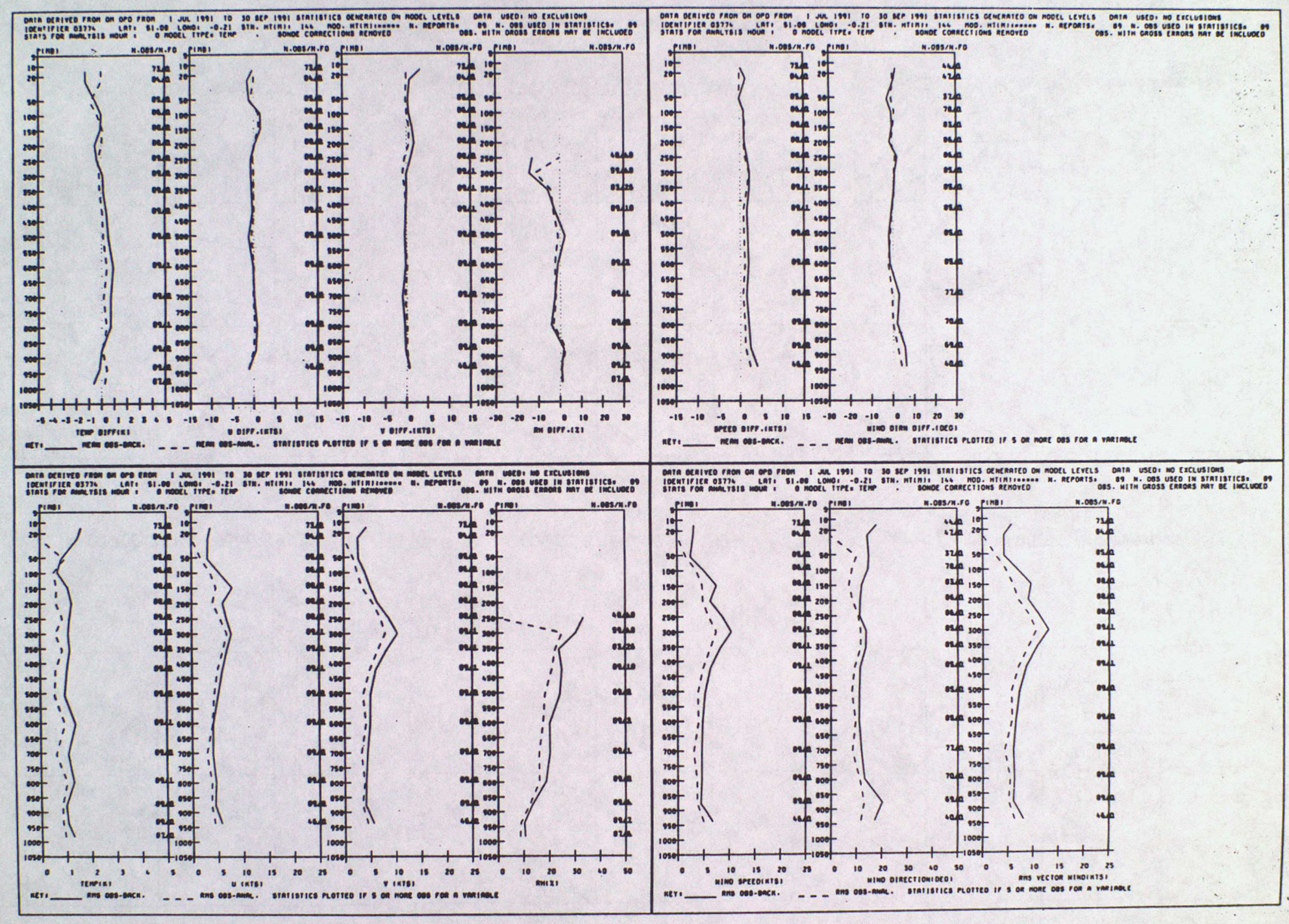
T+72. VT = 00UTC 3 November 1991

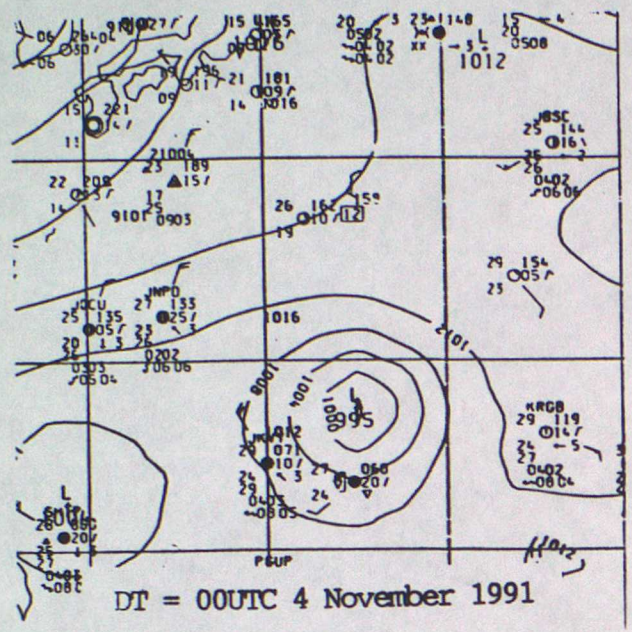


T+48. VT = 00UTC 3 November 1991

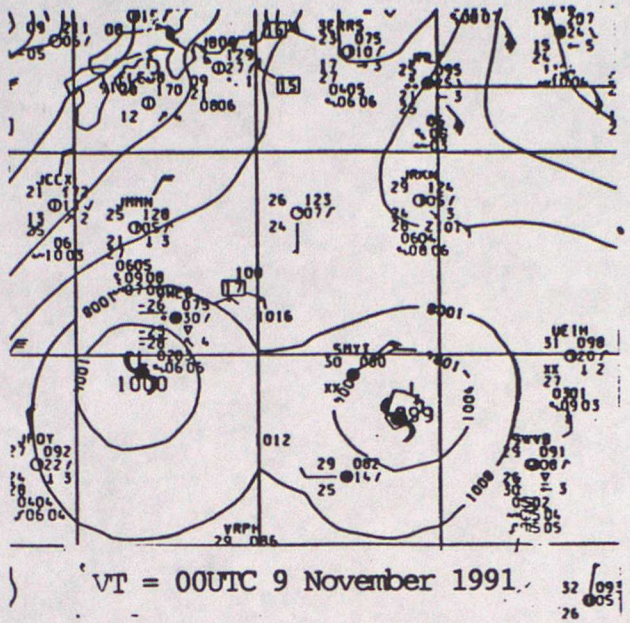
Figure 17. SETH. Verification time VT = 00UTC 3 November 1991. First reported 00UTC 1 November 1991 (VT-48).

URB.1


DATA DERIVED FROM GH OPD FROM 1 JUL 1991 TO 30 SEP 1991 STATISTICS GENERATED ON MODEL LEVELS DATA USED: NO EXCLUSIONS
IDENTIFIER 03774 LAT: 51.08 LONG: -0.21 STN. HT(M): 144 MOD. HT(M): N. REPORTS= 89 N. OBS USED IN STATISTICS= 89
STATS FOR ANALYSIS HOUR : 0 MODEL TYPE= TEMP . SONDE CORRECTIONS REMOVED OBS. WITH GROSS ERRORS MAY BE INCLUDED
P(MB) N.OBS/N.FC
TEMP DIFF(K)
U DIFF.(KTS)
V DIFF.(KTS)
RH DIFF.(%)
KEY: MEAN OBS-BACK. MEAN OBS-ANAL. STATISTICS PLOTTED IF 5 OR MORE OBS FOR A VARIABLE
SPEED DIFF.(KTS)
WIND DIRN DIFF.(DEG)
RMS OBS-BACK. RMS OBS-ANAL.
TEMP(K)
U (KTS)
V (KTS)
RH(%)
WIND SPEED(KTS)
WIND DIRECTION(DEG)
RMS VECTOR WIND(KTS)

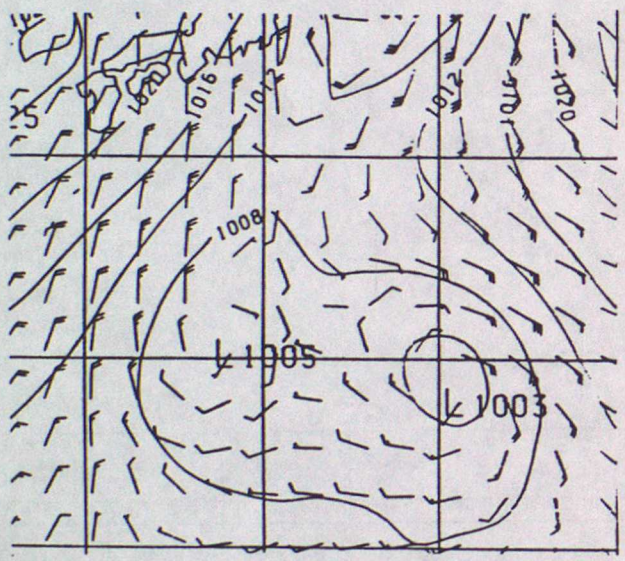


DT = 00UTC 4 November 1991

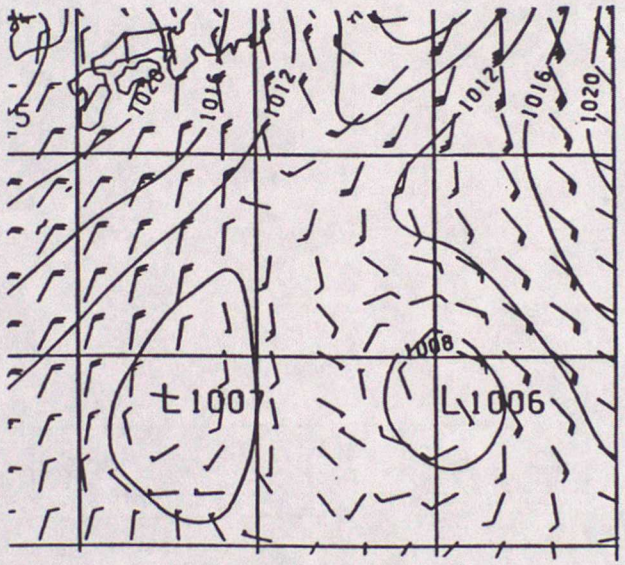


VT = 00UTC 9 November 1991

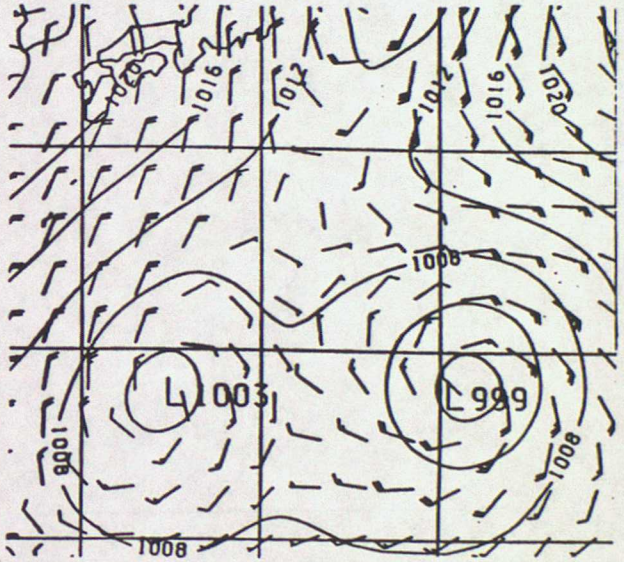
T+120. VT = 00UTC 9 November 1991



T+96. VT = 00UTC 9 November 1991



T+72. VT = 00UTC 9 November 1991

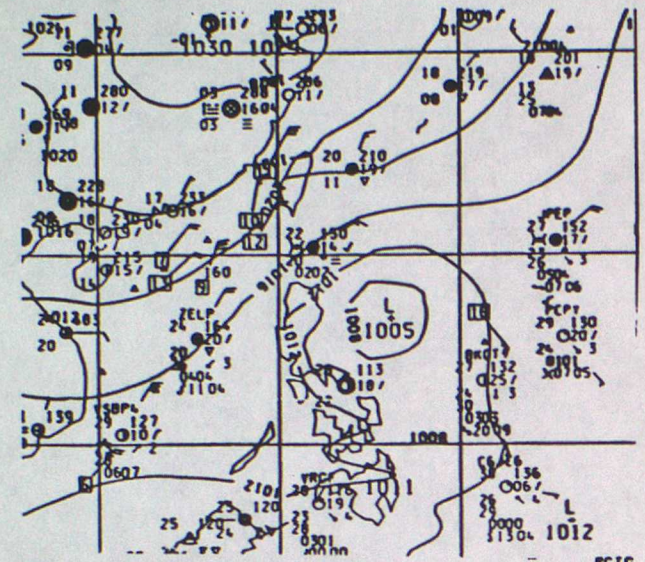


T+48. VT = 00UTC 9 November 1991

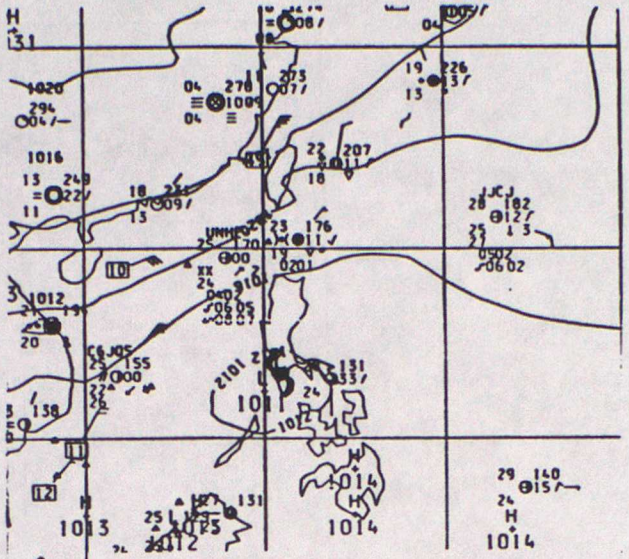
Figure 18. VERNE. Verification time VT = 00UTC 9 November 1991. First reported 18UTC 5 November 1991 (VT-78).

OVERFLOW PLOTS FOR DATA DERIVED FROM CM OPD 1 DEC 1990- 31 DEC 1990 & PLOTTED BY BAND(SIGMA DTA)
OBSERVATION AND FLAG COUNTS FOR MODEL DATA TYPE TMP.DATA UNUSED:FINAL FLAGS
PLOT IS: TOP:IDENTIFIER.LEFT:% FINAL FLG.RIGHT:N. OBS USED FOR STATISTICS
VARIABLE:VT WD PRESSURE BAND: 400- 150MB ANALYSIS HOUR: ALL

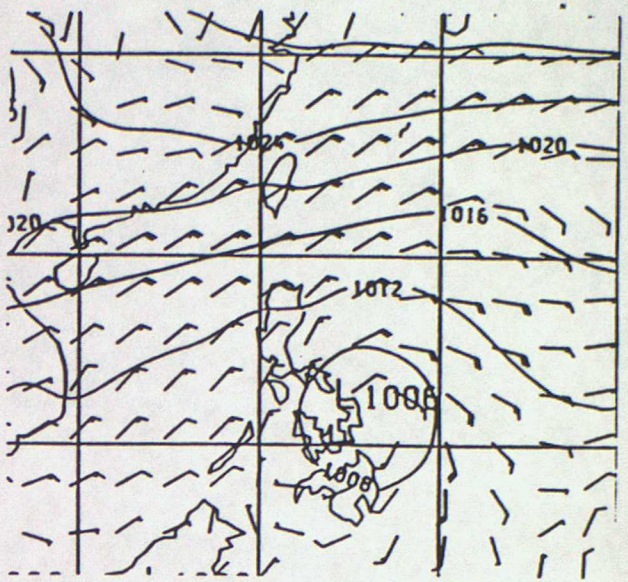
51.1 -0.2	94.4 10.2	52.7 7.3	52.8 9.7	52.5 13.4	51.1 9.3	49.7 7.3	48.3 11.8	48.8 8.9	50.8 14.5	52.4 16.8	48.3 20.1	44.7 11.6	52.1 23.7	48.8 22.3
03774 0 479	10046 1 245	10304 1 195	10130 0 430	10304 1 262	10137 4 258	10118 1 274	10060 0 409	10121 2 181	11520 2 448	12330 1 209	12702 0 236	10144 0 222	23060 0 239	23031 0 236



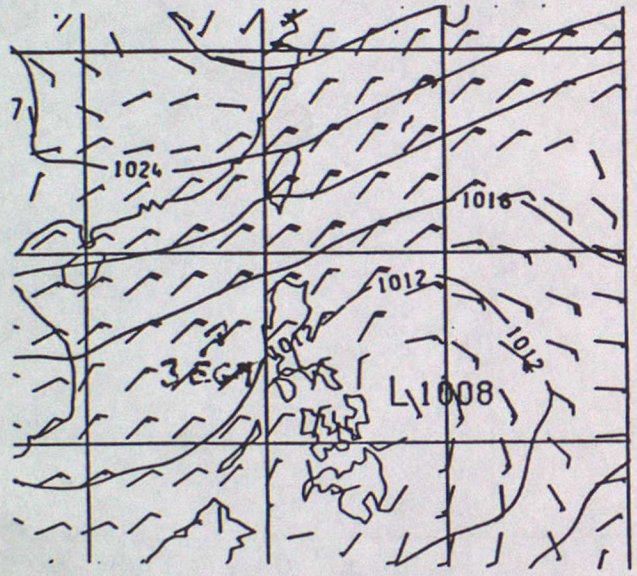
DT = 00UTC 12 November 1991



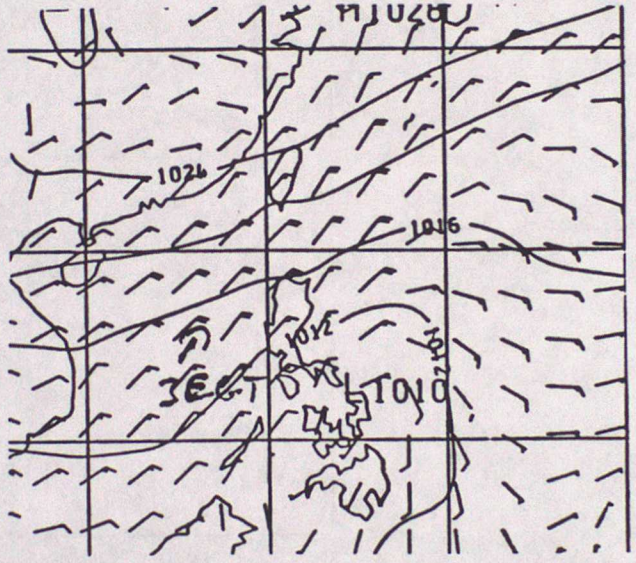
VT = 00UTC 17 November 1991



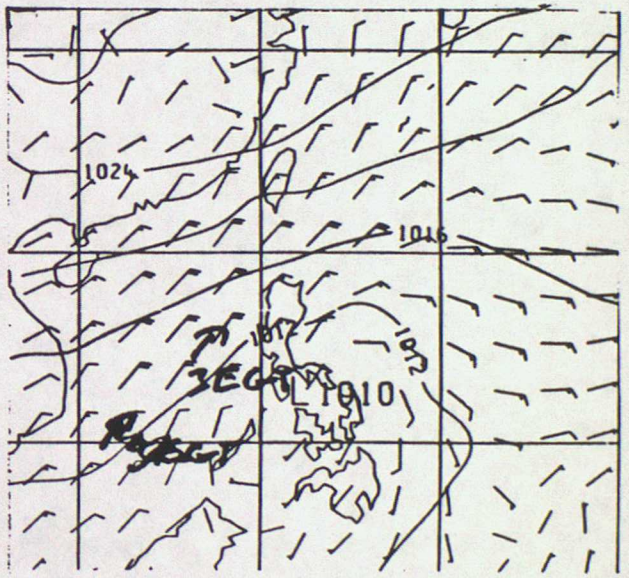
T+120. VT = 00UTC 17 November 1991



T+96. VT = 00UTC 17 November 1991



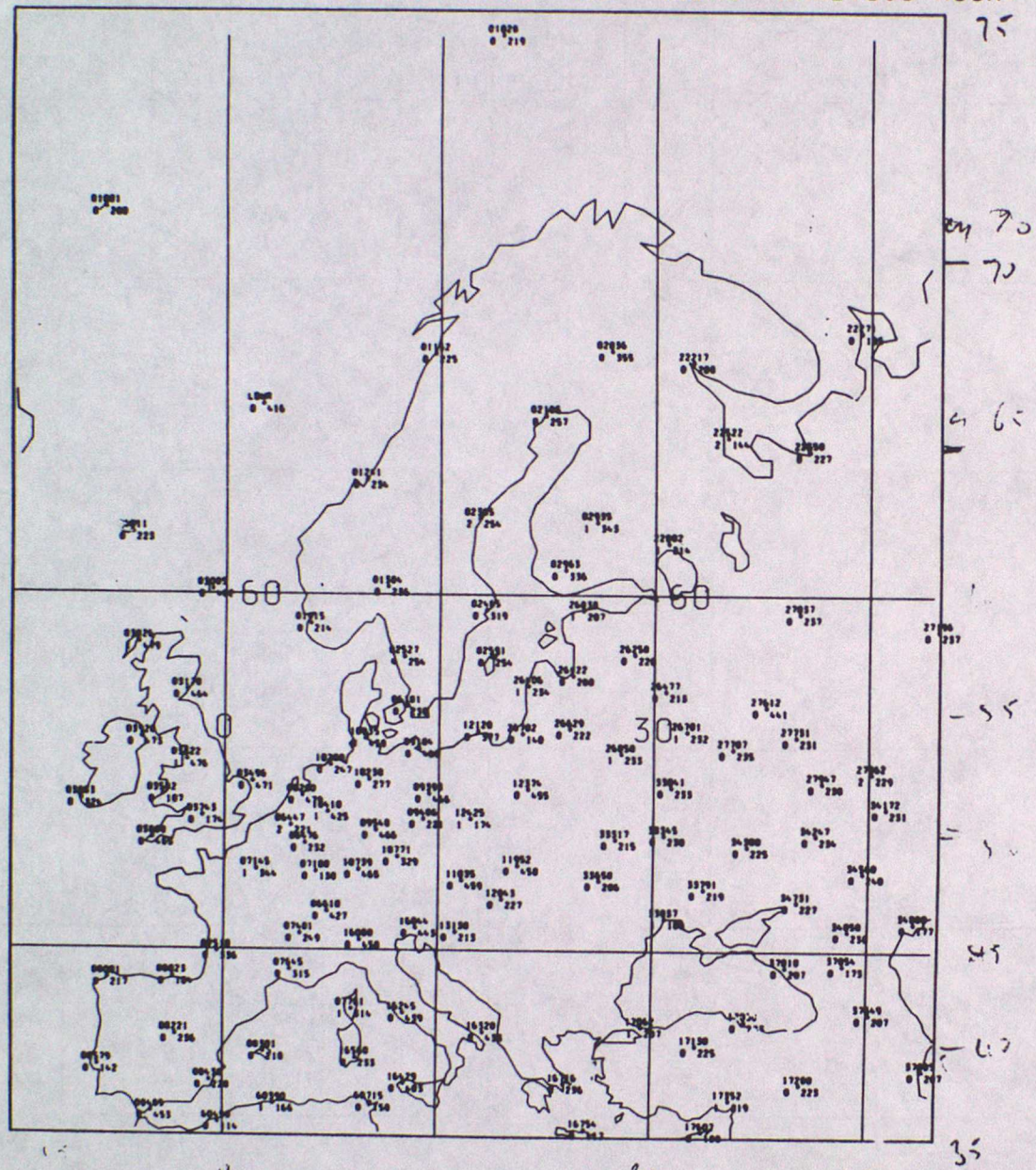
T+72. VT = 00UTC 17 November 1991

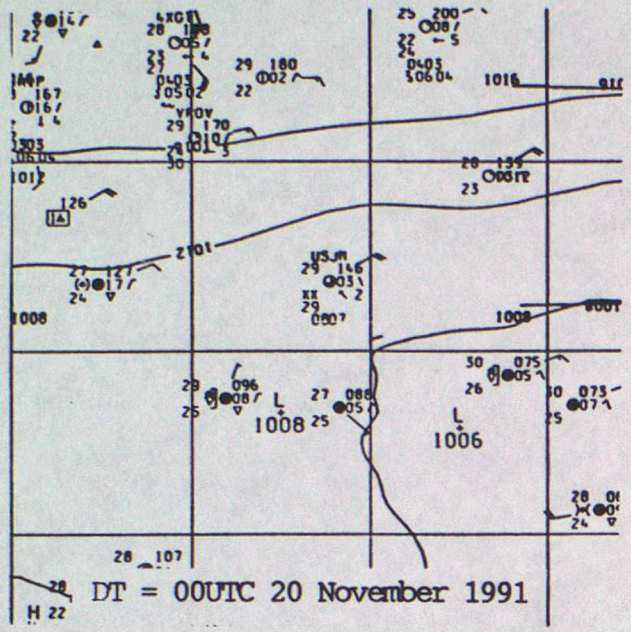


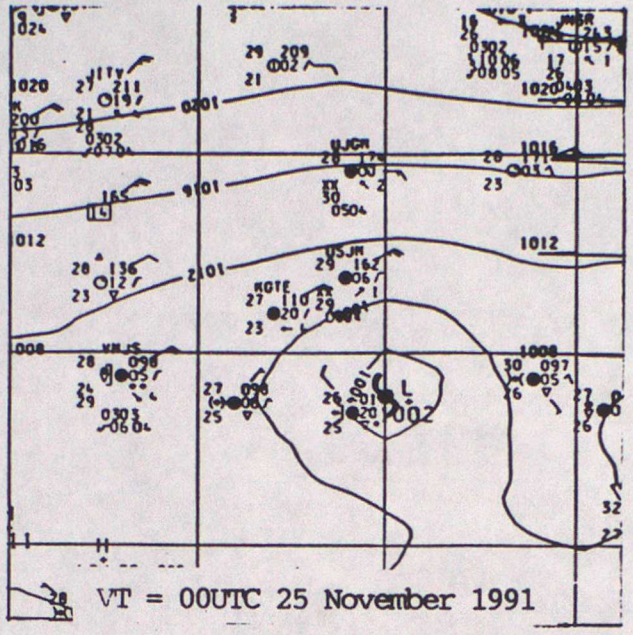
T+48. VT = 00UTC 17 November 1991

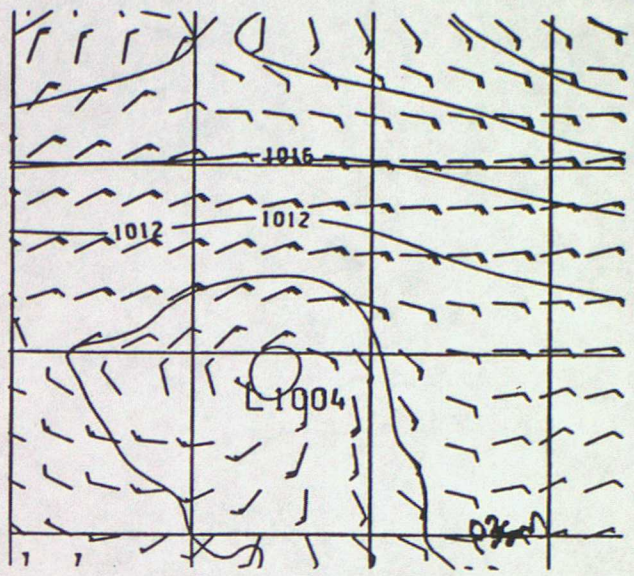
Figure 19. WILDA. Verification time VT = 00UTC 17 November 1991. First reported 18UTC 14 November 1991 (VT-54).

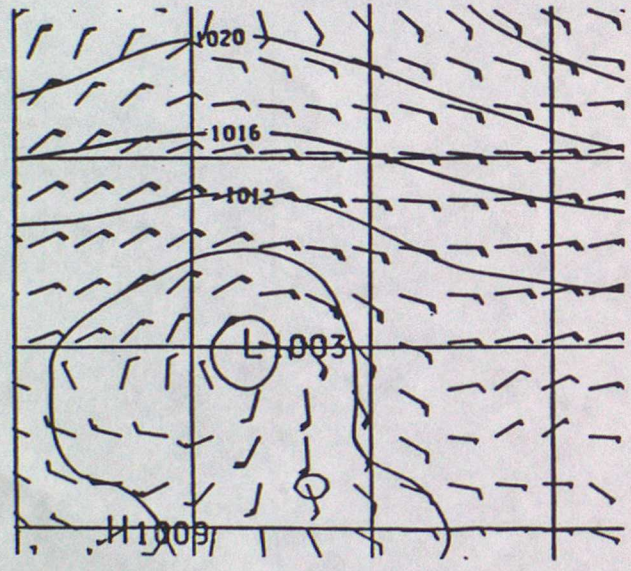
DATA DERIVED FROM CM OPD 1 DEC 1990- 31 DEC 1990 & PLOTTED BY BAND(SIGMA DTA)
OBSERVATION AND FLAG COUNTS FOR MODEL DATA TYPE TMP.DATA UNUSED:FINAL FLAGS
PLOT IS: TOP:IDENTIFIER.LEFT:% FINAL FLG.RIGHT:N. OBS USED FOR STATISTICS
VARIABLE:VT WD PRESSURE BAND: 400- 150MB ANALYSIS HOUR: ALL

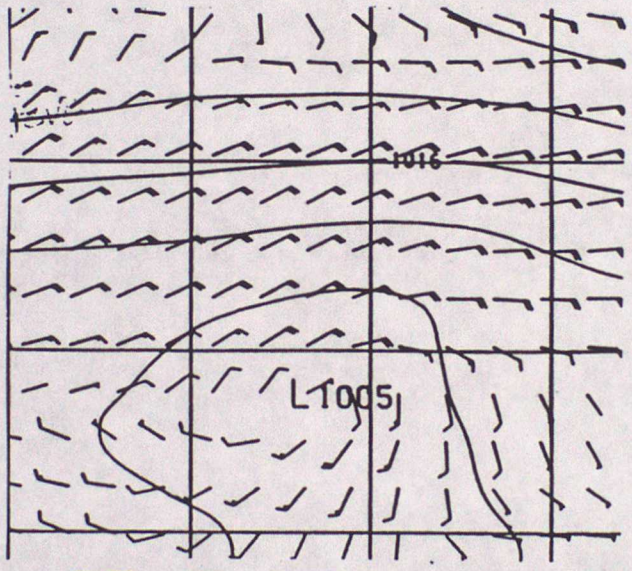












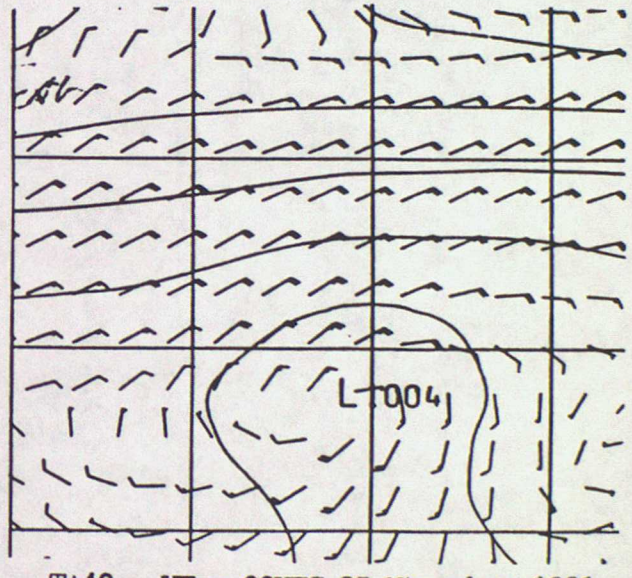


Figure 20. YURI. Verification time VT = 00UTC 25 November 1991. First reported 06UTC 23 November 1991 (VT-42).

Statistics of background winds relative to AIREPs

Statistics are shown for O-B (AIREP - 6 hour global forecast) for AIREPs between 100-400 hPa. Observations for which the vector wind difference from background exceeds 40 m per s are excluded from the analysis.

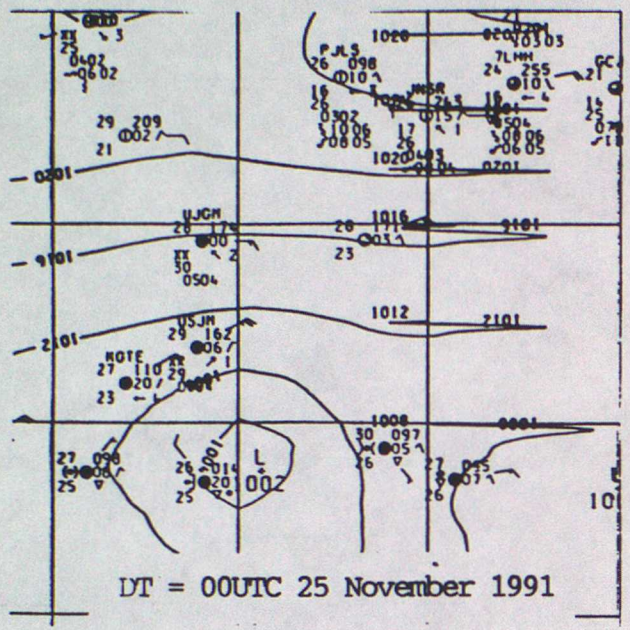
Table 1

Mean (O-B) speeds for the globe for different periods

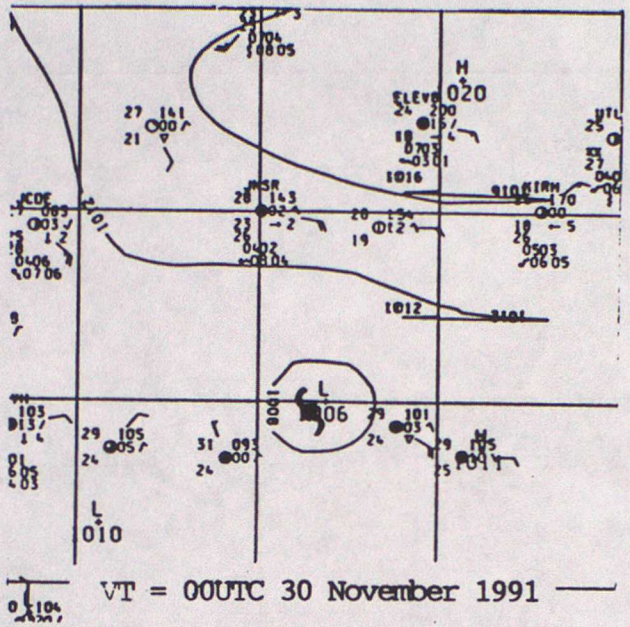
Column 1 - July - November 1991
Column 2 - December 1991

Mean of O,B speed m per s	Mean O-B speed m per s		Mean O-B speed as percentage of midrange speed		Number of obs. 000's	
	1	2	1	2	1	2
0-3	-0.8	-1.3			6	0.8
3-10	0.3	0.1			116	12
10-20	0.5	-0.5			190	29
20-30	1.2	0.9	4.8	3.6	136	33
30-40	1.5	1.5	4.3	4.3	88	28
40-50	2.3	2.1	5.1	4.7	55	19
50-60	3.3	2.9	6.0	5.3	31	11
60-70	4.2	3.6	6.5	5.5	16	6
70-80	5.2	4.3	6.9	5.7	6	3
>80	5.7	6.4	6.3 *	7.1 *	2	1.4
All	1.2	1.2			647	142

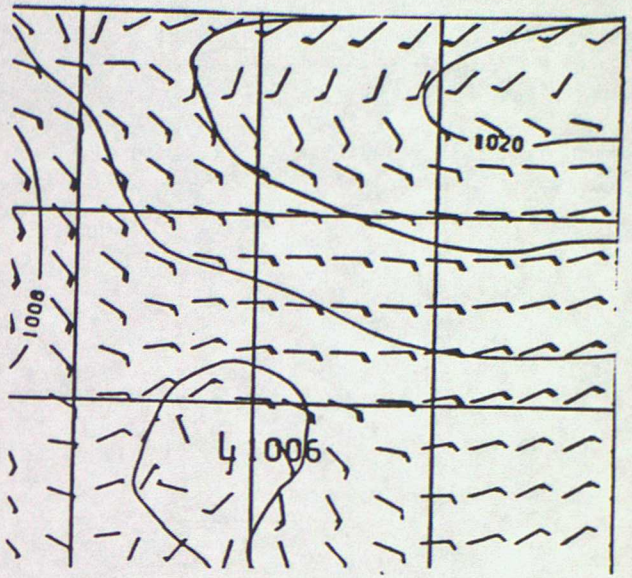
* assuming a mean speed of 90 m per s



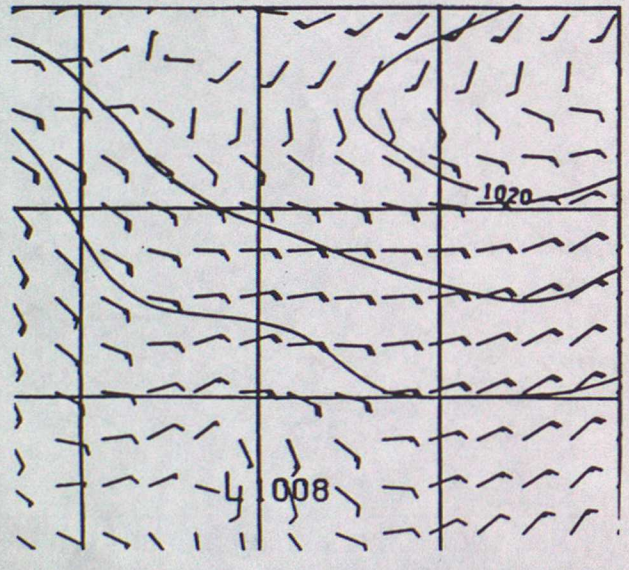
DT = 00UTC 25 November 1991



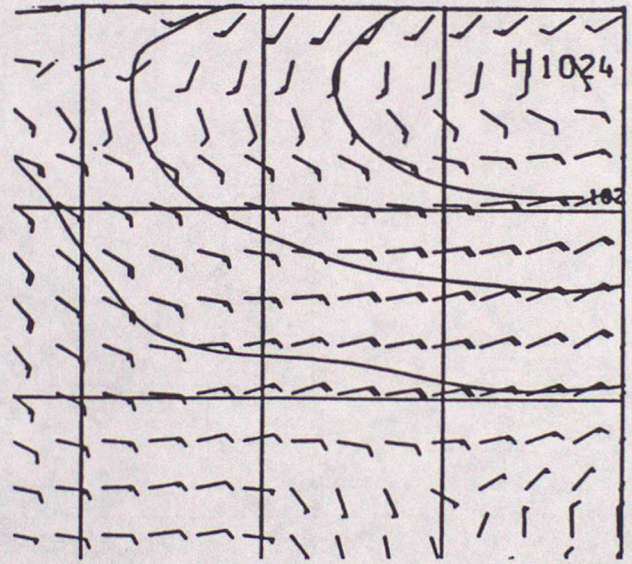
VT = 00UTC 30 November 1991



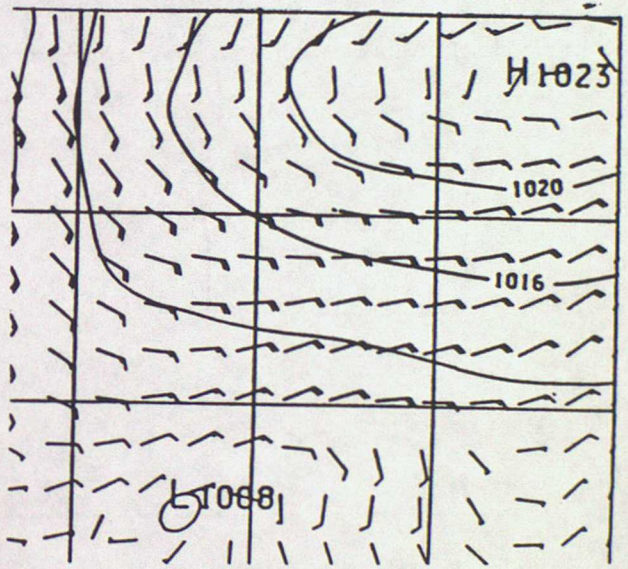
T+120. VT = 00UTC 30 November 1991



T+96. VT = 00UTC 30 November 1991



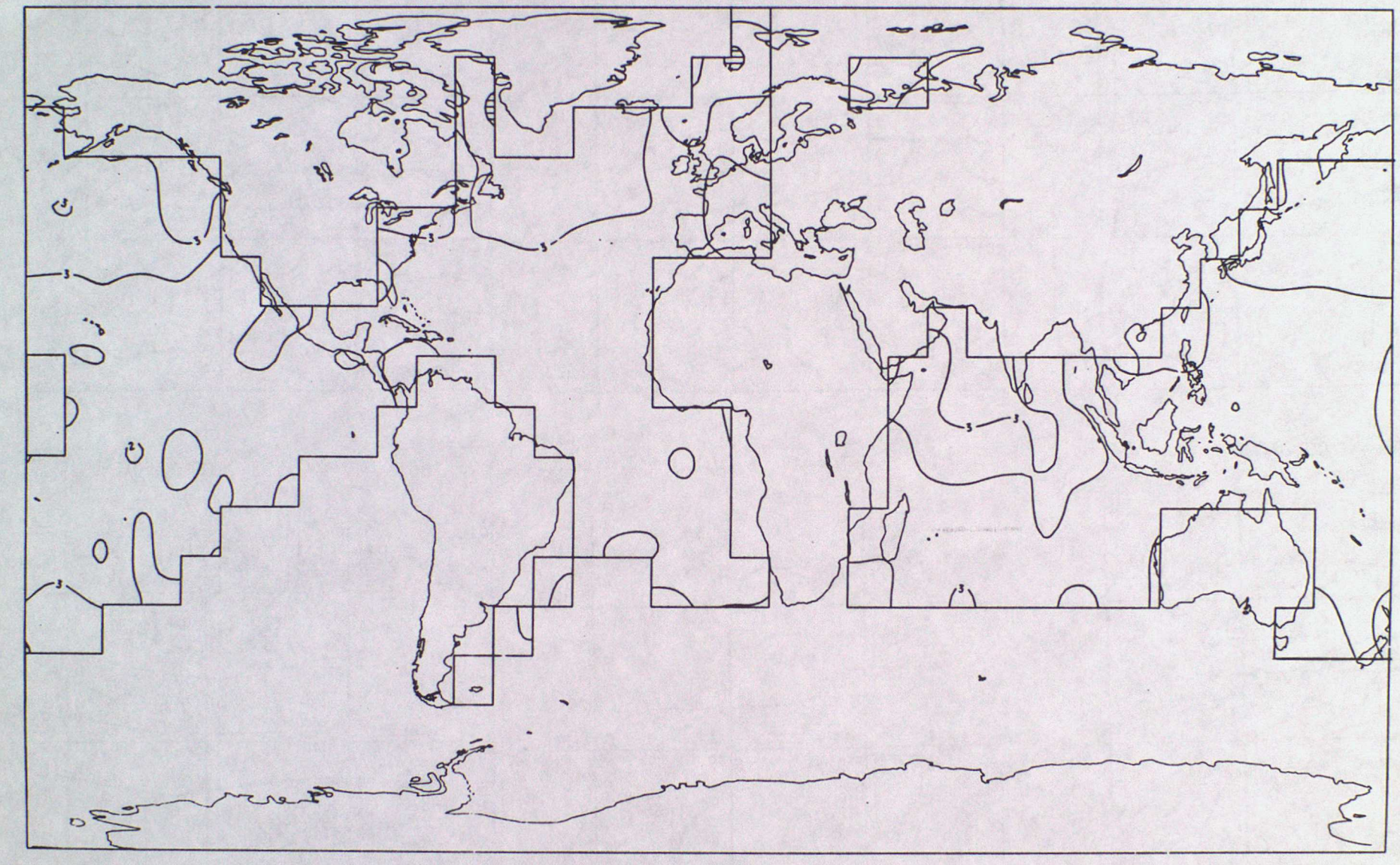
T+72. VT = 00UTC 30 November 1991

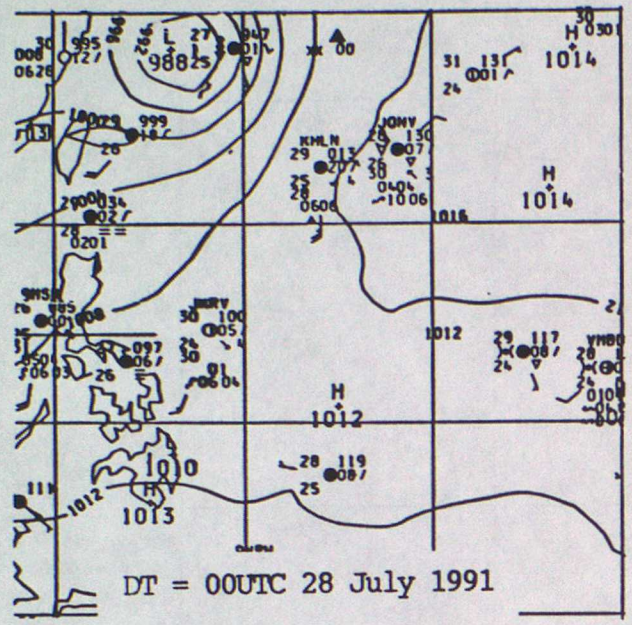


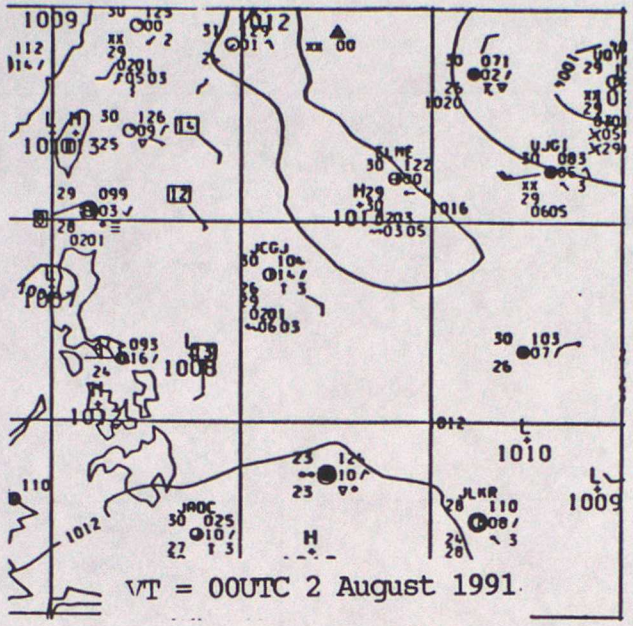
T+48. VT = 00UTC 30 November 1991

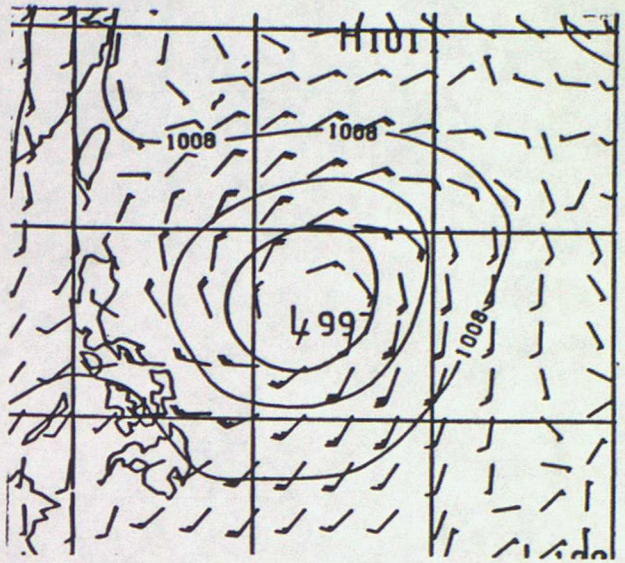
Figure 21. ZELDA. Verification time VT = 00UTC 30 November 1991. First reported 18UTC 27 November 1991 (VT-54).

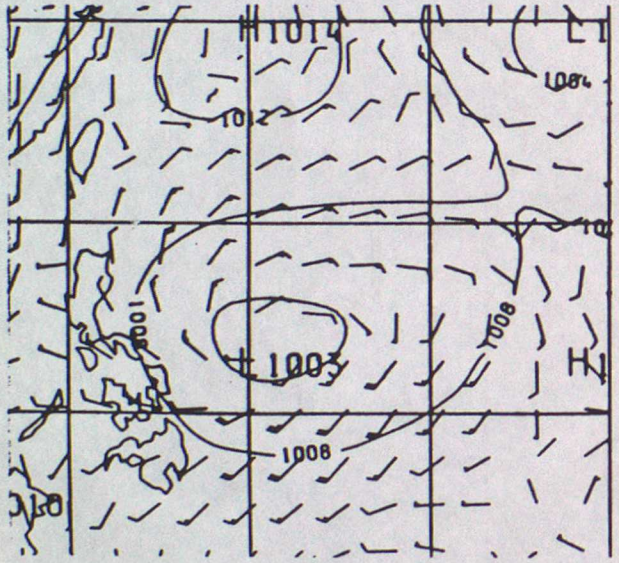
FIG 6: S.D. OF SHIP O-B WIND SPEED IN MS-1. PERIOD: JUL TO DEC 1991 06Z ANAL
ONLY OBSERVATIONS PASSING QUALITY CONTROL USED IN STATISTICS
CONTOURS DRAWN TO 10 DEGREE BOXES IF N. OF OBS > 10
AREAS SHADED HAVE STANDARD DEVIATION GREATER THAN 4.0 MS-1

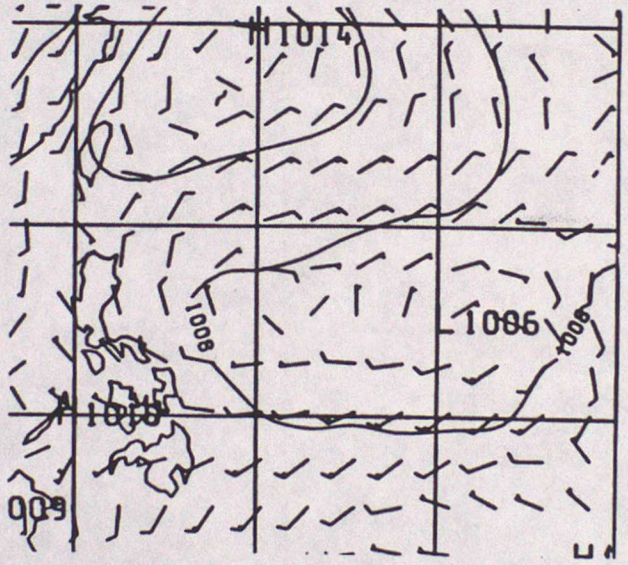












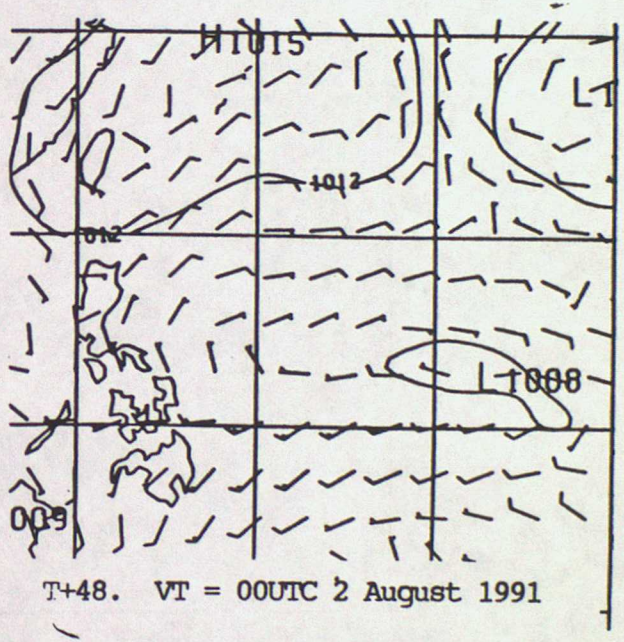
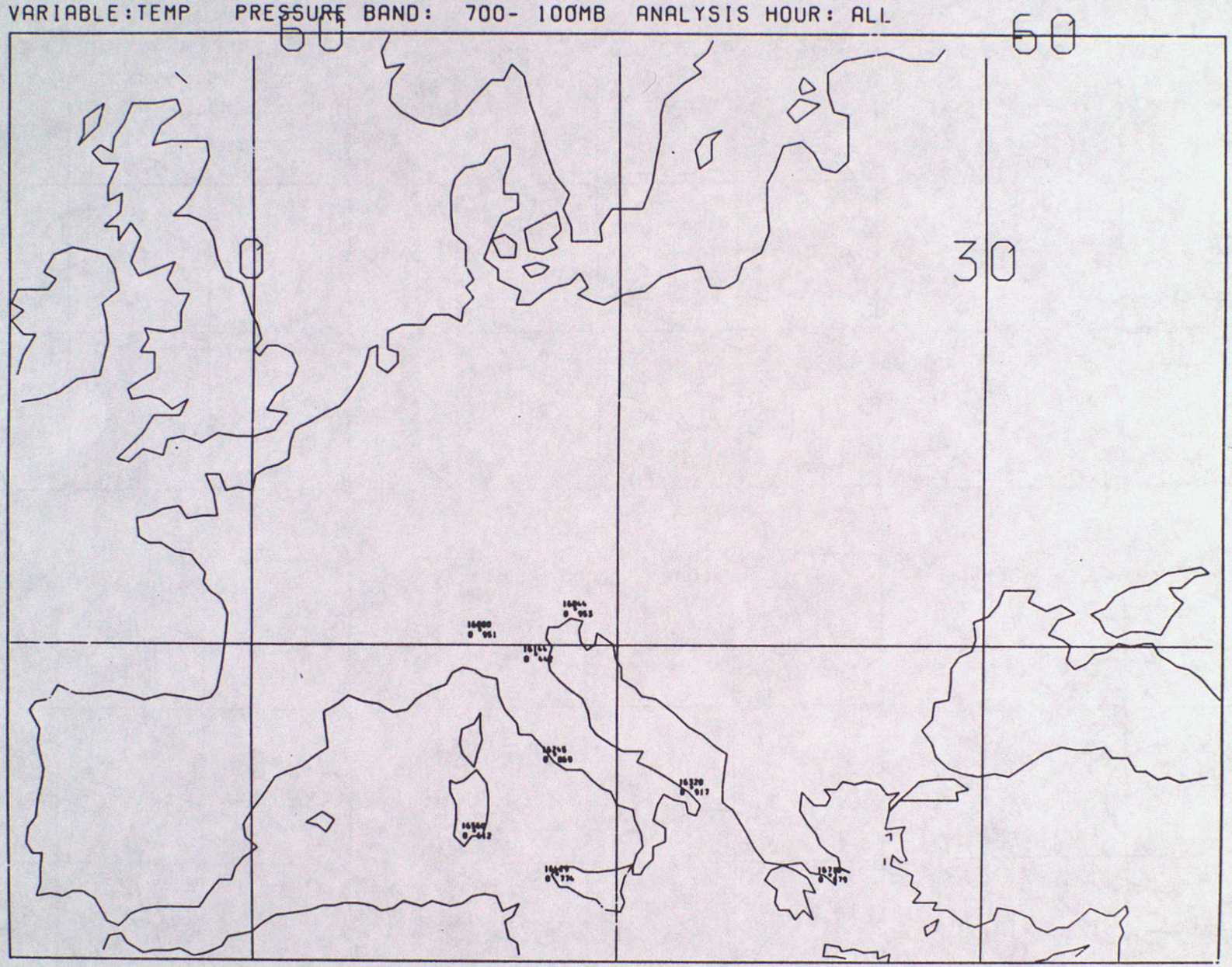


Figure 22. An example of a false alarm. Verification time VT = 00UTC 17 November 1991.

DATA DERIVED FROM CM OPD 1 NOV 1990- 31 NOV 1990 & PLOTTED BY BAND(SIGMA DTA)
OBSERVATION AND FLAG COUNTS FOR MODEL DATA TYPE TMP.DATA UNUSED:NONE
PLOT IS: TOP:IDENTIFIER.LEFT:% FINAL FLG.RIGHT:N. OBS USED FOR STATISTICS
VARIABLE:TEMP PRESSURE BAND: 700- 100MB ANALYSIS HOUR: ALL